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[OFFICIAL NOTICE.]

New England Association of Gas Engineers.

SECRETARY'S OFFICE, BIRMINGHAM, CONN., Jan. 15, 1891.

To the Members of the New England Association of Gas Engineers:—

The meeting of the New England Association of Gas Engineers will be held at Young's Hotel, Boston, Mass., on Feb. 18 and 19, 1891. The meeting will be called to order by the President, Mr. C. F. Prichard, on Wednesday, at 10 o'clock A.M.

It is hoped that all the members who can possibly attend will be present. As yet it is too early to give a list of papers which will be read, but it is believed that the coming meeting will prove no exception in this respect to those which have been held in the past, and that in the course of two weeks the announcement can be made of a goodly number of papers.

Persons eligible for membership and wishing to join the Association will please send to the Secretary for blank forms of application.

CHARLES H. NETTLETON, Secretary.

[OFFICIAL NOTICE.]

Annual Meeting of the Southwestern Gas Association.

SOUTHWESTERN GAS ASSOCIATION, DENISON, TEX., Jan. 5, 1891.

We herewith hand you a programme of the next meeting of the Southwestern Gas Association, to be held at San Antonio, Tex., on the 10th and 11th days of next March. The officials of the San Antonio Gas Company have expressed a willingness to provide accommodations for all attendants at our next meeting. You can communicate direct with them. You will please bear in mind the knowledge to be derived from the discussions from the papers to be read at these meetings. We expect a good attendance, and must have you with us. Do not fail to come. Our Question-Box is open for your queries. Information can be had through it that can be received through no other channels. Trusting to be favored with your presence, we are,

Yours fraternally,
WM. ENFIELD,
J. R. CULLINANE,
Committee on Programme.

Programme.

Address of President, A. E. Judge, Austin, Tex.

"Advantages of a Gas Engineer Being a Member of a Gas Association," by the President.

"Gas Coals of the Southwest," by Wm. Enfield, Dallas, Tex.

"Condensation and Leakage in the Southwest," by C. P. Russell, Galveston, Tex.

"Regenerative Furnaces in the Southwest," by E. A. West, San Antonio, Tex.

"The Steam Jet Exhauster and Condensation," by J. C. Lord, Fort Worth, Tex.

"Candle Power in Competition with Electric Lighting," by Leonard Gill, Corsicana, Tex.

"Electric Lighting in Connection with Gas Lighting: Comparative Prices and Profits of Each," by J. J. Walsh, Paris, Tex.

"Fuel Gas and Gas for Fuel," by J. R. Cullinane, Denison, Tex.

"Gas Making in the Southwest: Its Advantages and Disadvantages," by Joshua Gill, Houston, Tex.

"Market for Residuals in the Southwest," by J. L. Brockenborough, Waco, Tex.

"The Commercial Possibilities of Gas," by Thos. Miller, Fort Worth, Tex.

"The Gas Man's Easy Chair: Has he One?" by Maj. Davis, Sherman, Tex.

"Mains, Services and Drips," by Elmer Jones, Paris, Tex.

"Gas Stoves and a Special Price for Gas as Fuel," by G. R. Vaughn, Houston, Tex.

"The Alternating Current," by J. H. Maxon, Waco, Tex.

"Carrying Gas into Mexico and to Mexicans," by M. L. Hickey, El Paso, Tex.

BRIEFLY TOLD.

DEATH OF WILLIAM MOONEY.—Telegraphic despatches received at this office, on the afternoon of Thursday last, convey the shocking information that Mr. William Mooney, the well known architect of this city, and who for 30 years or more had devoted himself to planning in connection with gas works construction, died suddenly, in the rotunda of the National Hotel, Peoria, Ills., on the afternoon of Wednesday last, the 21st inst. Mr. Mooney, if we mistake not, was retained by the Peoria Gas Light Company to design and oversee certain improvements on its works, and his visit to that city was related to the task in hand. To say that we are shocked over his death is putting it all too mildly, for only a day or so prior to his departure for Peoria he called at the JOURNAL office, when he seemed to be and was in his usual vigorous health and exuberant spirits. In due time we will put before our readers some account of his life.

AGAIN THE CANDLE POWER OF ARC LIGHTS.—Some months ago the authorities of Allegheny City, Pa., reached the conclusion that it would be in line with progress and economy were the city to invest in an electric lighting plant, with the object of maintaining therefrom a supply of current to the public lamps. Elaborate plans were prepared and lengthy specifications were drawn up, and in the course of time bids were received from the several electric constructing companies, respecting the figures at which they would undertake the work. The Westinghouse Company, of Pittsburgh, naturally had the best chance at the outset in the competition, in that its factories were to all intents and purposes in the city of Allegheny; further, it was in line with the pride of home feeling that local pride would stretch a point or two over alloting the contract to the virtual home company. Although the Westinghouse Company's bid could not on a strict interpretation of its clauses, when analyzed on the basis of the specifications, be claimed to be the lowest, nevertheless the Company was awarded the contract. Under the agreement a certain number of arc lamps (2,000 candle power each) and another certain number of incandescent lamps (20 candle power each) were to be provided for; the contractors to furnish everything in the way of power and line equipment necessary to the maintenance of both classes of lamps; also to operate the same for the space of 6 months, at the end of which period, if the report of the experts named by the city to say whether the plant was up to standard or not was favorable, the contractors were to be paid the sum of $141,000, plus the expense of operating the plant during the 6 months probationary period. The work of construction was proceeded with, and about midsummer the lights were turned on. From the outset, complaint was made that the illumination yielded was not satisfactory, but as the tower system had been availed of largely by the planners of the system, this lack of light might be fairly chargeable to a defect in the planning rather than to imperfect or skimped work by the contractors. The probationary or trial period having run its course, the contractors asked for their money, whereupon the city appointed its experts to determine whether everything was as it should be in the construction, working and results of the system. Mr. Baird was selected to examine the power and electrical generating and conveying apparatus, and Prof. Very was retained to report upon the candle power of the lamps. Mr. Baird's report goes to show that the portions of the work which he was to examine are in every respect up to the specifications, hence the contractors and the city are to be congratulated; but not so with that which Prof. Very reports upon. He finds as follows: "I made tests of the arc lamps at several points. From the observatory I tested the lamps on the Lithgow avenue tower. Taking into account the smoky atmosphere, the percentage of light absorbed by the glass globe, and other adverse conditions, I estimate the candle power per lamp there to be 390. Another test made at the central station on Braddock street, with a naked arc, under much more favorable conditions, leads to the deduction that the *maximum* candle power of the Westinghouse arc light is 688." To which the Professor naively adds, "Thus you will see the arc lamps fall greatly below the power required by the specifications." In respect to which we might remark that the Professor seems to be speaking by the card. Turning now to Professor Very's findings in the incandescent lamp tests, he says, "One of the requirements is that the incandescent lamps shall burn 600 hours, and that at the end of that period they shall diffuse as much light as when new—20 candle power is required. From tests I find that when new the incandescent lamps exceed the required candle power, but when old they fall as low as 3 candle power. I judge the average candle power of these lamps is about 13.3." The Councils Committee, however, in the face of expert Very's report, recommended (by a vote of 8 to 1) that the plant be accepted, and that the contractors be released from further responsibility. It would be more satisfactory to our readers, no doubt, if we were able to give more precise details regarding the plant, but at present we are without them. Perhaps we may supply them at a later date. The cost to the contractors of operating the plant during the probationary period was $18,533.35.

SIXTH ANNUAL REPORT, MASSACHUSETTS STATE GAS AND ELECTRIC COMMISSION.—We are indebted to "Observer" for the following, from the columns of the Boston *Journal*, dated January 16:

"The sixth annual report of the Gas Commission, which has been sent to the Secretary of the Commonwealth, states that during the past year 73 gas companies and 60 electric light companies made returns, and suggests that legislation be had to secure such returns more promptly than now. Fourteen companies have been proceeded against, after two urgent notices, for failure to make returns, and it is suggested that a fine be imposed for each day's delay, so as to secure the returns in season for proper compilation for use by the Legislature.

"There is now no legal obstacle to the manufacture of water gas, and Lawrence and Pittsfield have added water gas works, while Athol has changed from water to coal gas.

"Although there has been a steady progress of electric lighting, there has been in most places a gradual increase in the consumption of gas. Data being now obtained will probably afford better information as to the comparative cost of gas and electricity. Electric motors are coming into more general use, although their cost has not been much lessened. It is suggested that the Board have power to call on the State Gas Inspector to test the candle power of the electric light; also that the report of the Inspector be combined with the report of the Board.

"In 24 cities and towns the companies furnish both gas and electric light. During the year the North Adams Gas Light Company has been allowed to furnish electric light, and the Worcester Gas Light Company refused the privilege. A detailed statement of the reasons in each case is given.

"During 1890 five persons were injured, three fatally, by electric light plants, and 23 persons were injured, 8 fatally, by illuminating gas, 2 of the latter being suicides.

"During the year 18 companies have reduced the price of gas. The number of gas meters during the year increased 3,892, and the street gas mains have been increased 54 miles. The number of public gas lamps has fallen off 1,776. During the year there were 12 electric light companies incorporated, with a total capital of $267,000. The electric light companies paid dividends of $153,708, only 21 out of 60 such companies paying dividends, however. The electric light central stations showed receipts of $1,920,702.05, and a balance of $579,887.45. The gas companies showed receipts of $5,270,991.04, and a net of $1,608,618.06.

"The report expresses high appreciation of the services of Major Rowell, who retired from the Board in July."

The Market for Gas Securities.

Consolidated gas was neglected during the week, and sold down on small offerings to 94¼. To-day (Friday) it is at 94½ to 94⅞, with some indications that a marked rally is close at hand. Other city shares are dull and neglected. In Brooklyn no change of moment is reported, although the backers of the Equity Company are prepared to and will go ahead. Chicago gas sold up to 47 +, and then dropped to 42. The opening price to-day was 43¼, as against the closing figure of 42⅝ last evening. Bay State, of Boston, sold up to 62-3, the recent decision of the Supreme Court, in the matter of the application of the authorities of Peabody for the right to operate a gas and electric light plant on municipal account, under the general law, having been unfavorable to the applicant. The decision is that a special act must be secured in such instances. This matter will be referred to at greater length subsequently in our news columns.

[A paper read before the Society of Gas Lighting.]

Lighting by Gas.

By Mr. M. S. Greenough.

Having recently been invited to make some remarks before a gathering known as the Merchant's Club on the development and present prospects of gas lighting in Boston and America, I got together a few statistics on the subject, and when I received on Monday a notice that a paper was expected from me to-day by this Society, I thought that perhaps they might be of interest here, although many of the facts are familiar to the members.

Wishing to begin my remarks properly, I looked up the question of the invention of illuminating gas, and found it to be claimed for both Murdoch and Lebon. Lebon has had a statue erected to him in France; Murdoch has so far escaped that doubtful honor, I believe. To have a statue erected to one's self in France would be gratifying, but when I remember the ordinary English statues with which the streets of London are adorned I think on the whole that Murdoch is better off without it. I will not weary you with the dates which I presented to the Club, except to call your attention to the fact that while the early experiments were being made in London a man named David Melville, of Newport, R. I., was working in the same direction here, and not only lighted a mill in Watertown, and two near Providence, but in 1813 lighted Beaver Tail Lighthouse. These facts are notable, and I had myself forgotten them.

Baltimore is entitled to the honor of starting the first gas company in 1817, but Boston followed soon after—1823. The experiment, however, was a failure, and the Company went into bankruptcy and was sold out. The present North End station was started in 1827.

The statistics of growth which I have are from 1841, and when put together every ten years are worth consideration.

Date.	Output, Cu. Ft.	Price.	Percentage.
1841.....	17,460,970	$5.00	—
1850.....	75,280,750	3.50	331.
1860.....	271,000,000	2.25	260.
1870.....	520,725,000	3.00	92.
1880.....	712,550,000	2.00	48.
1890.....	1,312,000,000	1.30	84.

Compare this with Philadelphia for the same time:

Date.	Output, Cu. Ft.	Price.	Percentage.
1841.....	51,272,000	—	—
1850.....	182,016,000	$2.25	257.
1860.....	639,578,000	2.25	251.
1870.....	1,241,485,000	2.55	94.
1880.....	2,173,010,000	2.00	75.
1889.....	3,151,149,000	1.50	45.

Now take Roxbury and South Boston, and the growth is equally satisfactory:

Roxbury.		South Boston.	
Date.	Cubic Feet.	Date.	Cubic Feet.
1860....	17,406,800	1860....	10,762,845
1870....	52,322,200	1870....	28,694,664
1880....	91,755,000	1880....	33,149,752
1890....	175,642,000	1890....	67,064,931

This makes the present consumption of gas in Boston about 44,000 cubic feet to each meter, or, calling the district supplied about 150,000, about 7,500 cubic feet per head of population.

Now, if Boston has practically doubled its output in the past ten years, right in the face of electrical development, what part has electricity played? So far as arc lighting goes, I think it is recognized as an assistance in the large cities by having raised the standard of light. What, however, has been done by the incandescent? To answer this question intelligently I tried to ascertain how many electric lights were in use in Boston at present. I was told that the Boston Electric Light Company had 8,000 in use. I inquired how many thousand feet of gas these were equivalent to. The ampere meters of the electric companies show what has been the number of amperes that have been sent out by them in 24 hours, and, estimating so many to a 16-candle power light, they can tell how much gas has been displaced. For 8,000 lights I was told there was an equivalent of 113,500 cubic feet of gas, or about 14 feet to a burner. The Edison Company claim to have about 40,000 lights in use in Boston, and about 30,000 in use at the time of their heaviest load. If, then, 40,000 lights had 14 feet to a light on an average, it would give, then, 560,000 feet of gas, which, added to 113,000, would make 673,000 feet of gas as the amount sent out by the two Companies in Boston at the present time, or about one-tenth the quantity of gas sent out in the districts in which they have incandescent light.

The capital invested in these Companies is much more than one-tenth of that invested in gas, and the price is about 50 per cent. more than that at which gas is now sold. It hardly looks to me as though the development of electric light in the next five years was going to be so great as that of the last five. There is a stratum in the consumers of gas, if I may use such an expression, who are going to displace it for electric light if they have not already done so; but I think this stratum is extremely limited in extent. I look during the next ten years for a development of gas, not only for lighting but for other purposes, which will fully equal the last ten.

Meters for Measuring Natural Gas.

The changing conditions in the supply of natural gas for fuel purposes are vividly shown in the rules that are being made by the companies engaged in such supply. The handwriting on the wall goes to show that the volume of gas from the wells is steadily decreasing; furthermore, that the time is close at hand when the companies will refuse to furnish gas to factories for the general operation of such works, unless the proprietors of the same will consent to pay *a rate per thousand cubic feet* far in excess of that which has so far been paid by them. The natural gas companies have determined from experience that the domestic consumer is the taker who will pay them the best rate, and that such supply can be maintained in accordance with a close estimate of the daily needs of the town or city. The average output for the 24 hours can be closely calculated, and, in fine, the business can be conducted on lines closely approaching those which govern the daily working of an artificial gas company.

The natural gas companies have about arrived at the conclusion that the house consumer will no longer be supplied on the contract basis—that is, in respect to the item of quantity. Which means that a fixed rate per 1,000 cubic feet on a supply through a meter is hereafter to be the rule and not the exception.

Several special types of meters for registering natural gas—notably the Westinghouse—have been on the market for some time, and have been fairly acceptable to the suppliers and users of natural gas. In fact, large numbers of ordinary dry meters are in use on natural gas, but there is the danger that irregularity of pressure, owing to defects in the distribution system, may lead to fracture and so to explosion.

The cut herewith presented illustrates a meter especially designed for measuring natural gas, which is being put on the market by the American Meter Company. The meter shown is capable of passing and measuring accurately 300 cubic feet per hour, at the regular or ordinary pressure obtaining in the supply of artificial gas. Of course this means that at the pressure usually found in the supply of natural gas to houses at least 33 per cent. increase in the hourly duty can easily be obtained

from it. The meters carry indices recording a maximum of one million cubic feet. The size shown is the one proven by experience to be the best adapted to use in ordinary households, as it is capable of passing gas to 7 fires. Where larger quantities of gas are required, two or more meters of the size illustrated can be employed, at a greater saving in expense than if one meter of a larger size were used; for large meters of equal strength increase very much in cost.

These meters will register gas supplied at a pressure equal to a column of water from 10 to 16 inches in height (about 5 to 8 ounces per square inch), or will work freely at the pressure of ordinary manufactured gas. The cases are of wrought iron, securely bolted, and are cylindrical in form, and the meter is finished in accordance with the well known practice of the Company.

[Concluded from page 81.]

Electrical Units of the Present and Future.

[An address by Prof. Francis B. Crocker, of Columbia College, before the New York Electric Club.]

We now come to self-induction. Self-induction is somewhat unfamiliar, nevertheless it is becoming important. Self-induction in telephone work, aerial, underground and submarine lines, dynamo armatures, dynamo field magnets, transformers and other alternating current apparatus are all practical cases of self-induction. We should consider self-induction almost as much as resistance. We have not done so heretofore, but that is no reason why we should not in the future.

It happens that there are several ways of defining self-induction, but the best way, I think, is to consider it as a counter electromotive force. That is to say, when I send a telephone current through an electromagnet the latter reacts against the current. When the current tries to go through, the magnet tries to oppose it. Therefore, the best way to define the unit self-induction is to say that it gives a unit counter electromotive force when there is a unit change of current in a unit time. The ordinary way, however, of deriving this unit is to multiply resistance by time. That seems to be an odd way to get it, but what it means is this: That self-induction is the apparent increase in resistance that we get when we try to pass a current through a circuit. If I put a current through the field magnet of a dynamo machine it will take some time before it reaches its full strength. The magnet will resist the current very much more than the mere resistance of the wire, if it were stretched out in a straight line, due to the fact that it is formed in a coil around a piece of iron. But after the current has got flowing, so to speak, then self-induction ceases to exist. It only occurs when a change is taking place.

The absolute units have no names; they are simply designated as absolute units of electromotive force, resistance, or quantity, as the case may be. This means that they are derived directly from the centimeter, gramme, and second, and "dimensions" of units are mathematical ways of expressing how these fundamental quantities enter each unit. Some of them involve all three of these quantities, some involve two, and some only one. Take, for instance, area. Area is L square; that is, the square of the length; for example, a foot square is an area. Volume is L cube. Velocity is L divided by T. That is, it is L multiplied by T to the minus one power. This enables us to put them all on the same line for convenience.

We come now to the practical units. Every one of these absolute units derived, as I said, is either so small or so big that they are not useful.

It was necessary to take a certain number of a fraction of an absolute unit. In the case of resistance they took such a number of absolute units in round numbers as would most nearly approach the Siemens unit which had been used before, and it happened to be 10^9 absolute units, which means that a billion of these little bits of absolute units will make one ohm, the practical unit of resistance, naming it after the discoverer of Ohm's law and establishing the precedent of naming all the electric units after distinguished electrical scientific men, which rule has been followed, without exception, to the last unit. They call 10^8, that is, 100,000,000 absolute units of electromotive force, a volt. That approximated most closely in round numbers to the Daniell cell which had previously been used as the unit of electromotive force. They selected the nearest units to the two units already in existence, and having fixed those, theoretical value of the ampere followed. It is one thing to select how many practical units you will have in one practical unit and it is another thing to determine it. The whole system could have been originated without making a single experiment. The ampere can be determined experimentally very much more easily than the volt or ohm, as I said, by balancing the effect of the current on the magnet with some known force. Now, it happens that we know the force of the earth's magnetism. It is not at all difficult to find out by suspending a magnet determining its time of swing and moment of inertia. Having determined the earth's magnetism, all you have to do is to balance the current effect on a magnet with the earth's effect on it, and knowing the earth's effect we know the current's effect, and, therefore, know the value of the current, which is the whole principle of a tangent galvanometer.

Thus the tangent galvanometer will give us the value of the current in absolute units, and if we take 10^{-1} of these we get the value in amperes. This is because the volt is 10^8 and the ohm is 10^9. Therefore, dividing one by the other in ohm's law, we obtain 10^{-1}. Having arrived at the current absolutely, we can also determine how much metal a current will deposit. But we cannot calculate it absolutely, however; we must determine it. I have here the exact weight of silver that one ampere will deposit in one hour. It was carefully weighed by the Assay Department of the School of Mines, and it is right to the tenth of a milligramme and weighs 4.0248 grammes. The ampere is a unit that is easily determined. The volt and the ohm require laborious work of years, and the original ohm, as determined by the British Association committee, was about 1½ per cent. wrong, which is a pretty bad mistake for a scientific measurement.

In making actual standards of these units, the volt is the most elusive one of all. The tangent galvanometer and the silver deposition give up the ampere pretty well, and for the ohm we have a definite coil. But the volt is dependent on standard cells containing chemicals that are very apt to change. They are compounds and they are apt to decompose or change in their composition.

It happens that the unit of capacity, the farad, is a very large unit, and we have to take a millionth of it to get a working unit. The microfarad is the standard, and it is a pretty good-sized standard. It is equal to the capacity of 2 or 3 miles of the Atlantic cable. It would contain the same quantity of electricity as 2 or 3 miles of Atlantic cable, and it would take 1,000 Atlantic cables to equal 1 farad in capacity. Therefore, you see that what is called the "practicable unit" of capacity is very unpracticable. The reason the farad is so large is that we have obliged ourselves to define units in terms of 1 volt, 1 coulomb, etc. Now, with static electricity, 1 volt is very small. Our ordinary static charges are 100,000 volts or more; for instance, it takes about 100,000 volts to spark 1 inch.

Now a static spark to jump an inch is not a particularly large one. These, to take the volt to determine the unit of static capacity, make it necessary to have a tremendous capacity to hold our coulomb at that very low electrical pressure.

I would like to point out the fact that we have "absolute units" and practical units," so called. (I put both of these in quotation marks.) Absolute, units, as I have said, are not absolute, they are based on arbitrary dimensions of the earth incorrectly measured. Now, practical units in the same way are not practical, because we have one, the farad, that is 1,000 times greater than the greatest practical capacity in existence. Therefore, I maintain that we must have a third system of units, and that is the "working" units. You could call them "commercial," but the objection to that is that they are equally used in the laboratory as in commercial work. We use a microfarad in the laboratory the same as in the office of a telephone or cable company. Therefore they are not, strictly speaking, commercial, but they are *working* in both cases. Sometimes the working units agree with the practical and sometimes they do not. The ampere, coulomb and volt are the same, although in telegraphy we use the milliampere. Then we come to the ohm. That is, the ohm is right for most practical work, but for insulation tests we have to use a megohm. Nobody thinks of giving insulation tests except in megohms. Therefore, for that class of work, the working unit is the megohm and not what is called the practical unit.

When we come to the microfarad there is no question. The practical unit ceases entirely to be practical, and we have to adopt the working unit, which is almost infinitely different.

The watt is a convenient unit for a great many purposes, but when we use it for large work we use the kilowatt, which, by the way, is a good way of rating dynamos, because it is fairly near a horse power.

Then we come down to the last of all—the henry, the new member of the family, and it is a question whether the working unit will be a henry or a millihenry. I did think of reducing the value of the henry to $\frac{1}{1000}$ of its value, as given in the table; but it would have been a mistake, for the reason that, instead of having its value 1 second multiplied by 1 ohm, we would have its value a second multiplied by $\frac{1}{1000}$ of an ohm or $\frac{1}{1000}$ of an ohm. That would be destroying the simplicity and the harmony of this system—a feature which it certainly does possess. Every one

of these units is derived from every other one in the simple ratio of 1 to 1, and in no case is there any complex relationship of $\frac{1}{10^6}$ or $\frac{1}{10^{6^6}}$ or anything of that sort. You see that the coulomb is an ampere multiplied by a second, a volt is 1 ampere multiplied by an ohm, a farad is a coulomb divided by a volt. A joule is a volt multiplied by a coulomb, and a henry is a second multiplied by an ohm; and to make any one of them anything would, I think, be a mistake, particularly as it would have been the only exception to the harmoniousness of the system.

Fortunately, the henry approximates a practical value. For example, a large Edison dynamo, shunt wound, will run up to 1 or more hundred henrys. A telephone magnet will be between $\frac{1}{100}$ and $\frac{1}{10}$ of a henry. We could not expect that to be a very large value. An ordinary relay is several henrys in value. A large induction coil is often 1,000 or more henries in value. Therefore there is nothing preposterously small or large about the henry. It is about right. I have given in the last column of the table the actual or experimental value. That is, 4.025 grammes of silver per hour is the ampere. The volt is .926 of a Daniell cell. The legal ohm is 106 centimeters of mercury 1 square millimeter in cross section, etc. The unit of self-induction is equivalent to the length of the earth's quadrant. Thus we see that often starting with the earth's quadrant in this system of units, to obtain the fundamental units of length, and passing through all the mechanical units and the electric units, we finally get back to the earth's quadrant again. It is certainly quite remarkable and striking. It is a fact, nevertheless, that the unit self-induction is properly represented by a length equal to the earth's quadrant. In fact, it has been called the quadrant, and was so called by the Paris Conference, which, I think, was a great unfairness to American electrical men, both living and dead, because certainly America's contributions to electrical science and industry have been fully equal to those of any other country; and if England has the farad, joule and watt, named in honor of her distinguished electrical scientists, if France has the coulomb and the ampere, if Germany has got the ohm, and if Italy has got the volt, I think it is certainly not unreasonable for us on this side of the Atlantic to ask for 1 unit, to be named after the discoverer of self-induction, Joseph Henry.

In regard to future units, which the requirements of advanced work will soon necessitate, we need a unit of the strength of a magnetic field. We can express it as so many lines of force to the square centimeter, etc., but that is a very clumsy way. If we simply called it one franklin it would be very preferable to a long sentence. We all have in mind the naming of some electric unit after Franklin, but, unfortunately, Franklin is not identified with magnetic work. He is identified with electrostatic work; but all the electrostatic units have been named. But perhaps his name may be adopted. We shall certainly require within a short time a magnetic unit defining the number of lines of force, and we will speak of a field as so many units, and we will have a name for it; and when we use it every one will know what we mean. The naming of a new unit, and giving it its value, and deciding what it shall be, are very difficult questions. An error might cause considerable trouble and loss of time and all sorts of bad results, whereas the proper selection of a unit would greatly facilitate work.

This treatment of units is necessarily superficial, and all I have attempted to do is to show you the general derivation of them, starting with the very first conception and coming to the present time and a little beyond. In fact, by giving you some inkling of what the probability of new units is.

[From the London *Journal*.]

Gaseous Illuminants.

[An abstract of the fifth (and last) lecture of the series on this subject recently delivered before the Society of Arts, by Prof. Vivian B. Lewes. For abstracts of the preceding lectures see JOURNAL, Dec. 22, 1890, p. 877; Jan. 5, 1891, p. 3; Jan. 12, 1891, p. 42; Jan. 19, 1891, p. 76.]

The last of the series of the Cantor Lectures on the above subject was given at the Society of Arts by Prof. Vivian B. Lewes, F.I.C., F.C.S., on Monday evening, last week; the matters discoursed upon being the combustion of coal gas and the probable future of gaseous illuminants and heating gases.

The lecturer commenced by saying that, having brought before his audience the various methods by which ordinary coal gas can be enriched, so as to give an increased luminosity to the flame, he wished to discuss the methods by which it can be burnt in order to yield the greatest amount of light, and the products which result during combustion. He then went on to remark that in the first lecture, while discussing the theory of luminous flames, he pointed out that in an atmospheric burner it was not the oxygen of the air introduced combining with and burning up the hydrocarbons, and so preventing the separation of incandescent carbon, which produced a non-luminous flame, but the diluting action of the nitrogen, which acted by cooling the flame; thus preventing a temperature being reached at which the hydrocarbons are broken up, and the carbon liberated—a fact which was proved by his showing that heating the mixture of gas and air again restored the luminosity of the flame. This experiment clearly showed that temperature is a most important factor in the illuminating value of a flame; and this is still further shown by a study of the action of the diluents present in coal gas—the non combustible ones being far more deleterious than the combustible, as it is found that they not only dilute, but withdraw heat. Anything that will increase the temperature of the flame will also increase the illuminating power; provided, of course, that the increase of temperature is not obtained at the expense of the too rapid combustion of the hydrocarbons, as was shown by experiment when studying the action of diluents on flame. Oxygen added to coal gas increases its illuminating value to a marked and increasing degree until a certain percentage has been added; after which the illuminating power is rapidly decreased, until the point is reached when the mixture becomes explosive. This is due to the fact that the added oxygen increases the temperature of the flame by doing the work of the air, but without the cooling and diluting action of the nitrogen. When, however, a larger proportion is added, it begins to burn up the heavy hydrocarbons; and although the temperature goes on increasing, the light giving power is rapidly lowered by the diminution of the amount of free carbon in the flame.

It has been proposed to carburet and enrich poor coal gas by admixture with it of an oxy-oil gas made under Tatham's patents, in which crude oils are cracked at a comparatively low temperature, and are then mixed with from 12 to 24 per cent. of oxygen gas. Oil gas made at low temperature is *per se* of little use as an illuminant, as it burns with a smoky flame, and does not travel well; but when mixed with a certain amount of oxygen it gives a very brilliant white light and no smoke, while, as far as experiments have at present gone, its traveling powers are much improved. At first sight it seems a dangerous experiment to mix a heavy hydrocarbon gas with oxygen; but it must be remembered that, although hydrogen and carbon monoxide only need to be mixed with but half of their own volume of oxygen to produce the most explosive compound, yet as the number of carbon and hydrogen atoms in the combustible gas increases, so does the amount of oxygen needed. So that coal gas requires rather more than its own volume, and ethylene three times its volume, to yield the maximum explosive results; while these mixtures begin to be explosive when 10 per cent. of oxygen is combined with hydrogen or water gas, 30 per cent. with coal gas, and more than 50 per cent. with oil gas of the character used. It is claimed that if this gas were used as an enricher of coal gas, 5 per cent, of it would increase the luminosity of 16-candle gas by about 40 per cent. Oxygen has been obtained for some time past from the air, on a commercial scale, by the Brin process; but it has never been produced so cheaply as to allow of its free use for industrial purposes. At the present time, however, there seems every prospect of our being able to obtain very pure oxygen at a low rate. The process by which this important result is to be obtained is as old as the hills, and was first introduced by Tessie du Motay, and consists of passing alternate currents of steam and air over sodic manganate heated to dull redness in an iron tube. The process has never been commercially successful, for the reason that the contents of the tube fused, and, flowing over the surface of the iron, rapidly destroyed the tubes or retorts; and also, as soon as fusion took place, the mass became so dense that it had little or no action on the air passing over it. Now, however, Mr. Bowman claims that he has overcome this difficulty by preparing the manganate in such a manner as to entirely prevent fusion, and to keep it in a spongy state, which gives very high results; and the substance being practically everlasting, the cost of production is extremely low. It is proposed to feed this by a separate system of pipes to small gas jets; and by converting them into practically oxy-hydrogen blow-pipes, to raise solid masses of refractory material to incandescence, and also by supplying oxygen in the same way to oil lamps of particular construction, to obtain a great increase in illuminating power. Whether these methods of employing oxygen will be successful or not I do not wish to discuss at the present time; but there is no doubt that cheap oxygen would be an enormous boon to the gas manager, as, by mixing 5 per cent. of oxygen with his coal gas before purification, he could not only utilize the method so successfully introduced by Mr. Valon at Ramsgate, but could also increase the illuminating value of his gas to a slight extent.

In speaking of the structure of flame, I pointed out that close to the burner from which the gas giving the flame is issuing, a space exists in which no combustion is going on; in other words, a flame is never in

contact with the rim of the burner. This is best seen when the gas is turned low. With a batswing burner, for instance, turned so low that only a small non-luminous flame is left, the space between burner and flame will appear as great as the flame itself; while if the gas is mixed with an inert diluent like carbon dioxide, the space can be very much increased. Several theories have been brought forward to explain this phenomenon; but the true one is that the burner abstracts so much heat from the flame at this point that it is unable to burn there. This can be proved by the fact that where a cold object touches the flame a dividing space similar to that noticed between flame and burner will always be observed; and the colder the object, and the more diluted the gas, the greater is the observed space. If a cold metal wire or rod is held in a non-luminous flame it causes an extinction of the gas for some considerable space around itself; but, as the temperature of the rod rises, this space becomes smaller and smaller, until the rod is heated to redness, and then the flame comes in contact with the rod. In the same way, if the burner from which the gas is issuing be heated to redness the space between burner and flame disappears. It has already been shown that cooling the flame by an inert diluent reduces the illuminating value, and finally renders it non-luminous; and we are now in a position to discuss the points to aim at in the construction of a good gas burner. In the first place, a sensible diminution in light occurs when a metal burner is employed; and the larger the surface and thickness of the metal the worse will be its action on the illuminating power of the flame. But this cooling action is only influencing the bottom of the flame. With a small flame the total effect is very great; with a large flame, almost *nil*. The first point, therefore, to attend to is that the burner should be made of a good non-conductor. In the next place, the flow of the gas must be regulated to the burner; as, if you have a pressure higher than that for which the burner is constructed, you at once obtain a roaring flame and a loss of illuminating power, as the too rapid rush of gas from the burner causes a mingling of gas and air, and a consequent cooling of the flame, while the form of the flame becomes distorted. The tap also which regulates the flame is better at a distance from the burner than close to it, as any constriction near the burner causes eddies in the flow of the gas which gives an unsteady flame. These general principles govern all burners.

We will now take the ordinary forms in detail. In the flat-flame burner, given a good non-conducting material and a well regulated gas supply, little more can be done, while burning it in the ordinary way, to increase its luminosity; and it is the large surface of flame exposed to the cooling action of the air which causes this form of burner to give the lowest service of any per cubic foot of gas consumed. Much is done, moreover, by faulty fittings and shades, to reduce the already poor light afforded, because the light-yielding power of the flame largely depends on its having a well-rounded base and broad luminous zone; and when a globe with narrow opening is used with such a flame, as is done in ninety-nine cases out of a hundred, the up-draught drags the flame out of shape, and seriously impairs its illuminating power—a trouble which can be overcome by having a globe with an opening at the bottom not less than 4 inches in diameter, and having small shoulders fixed to the burner which draw out the flame and protect the base from the disturbing influence of draughts.

The Argand burner differs from the flat flame burner in that a circular flame is employed, and the air supply is regulated by a glass of cylindrical form. This kind of burner gives better service than a flat flame, as not only can the supply of gas and air be better adjusted, but the air being slightly warmed by the hot glass, adds to the temperature of the flame, which is also increased by radiation from the opposite side of the flame itself. The chief loss of light depends upon the fact that being circular, the light from the inner surface has to pass through the wall of flame and careful photometric experiments show that the solid particles present in the flame so reduce its transparency that a loss amounting to about 25 per cent. of light takes place during its transmission. The height of flame also must be carefully adjusted to its size; as too long a chimney, by increasing the air supply, unduly cools and so lowers the illuminating power of the flame. Experiments with carbureted water gas gave the following results:

Size of chimney...	6 × 1¾ in.	7 × 1⅞ in.	8 × 1⅞ in.	9 × 1⅞ in.
Height of flame...	2½ in.	2¼ in.	2¼ in.	1⅞ in.
Ill. power (candles)	21.0	21.3	20.8	18.2

For many years no advance was made upon these forms of burner. But when, 15 years ago, it was recognized that anything which cools the flame reduces its value, while anything which increases its temperature raises its illuminating power, a change began to steal over the forms of burner in use; and the regenerative burners, fathered by such men as Siemens, Grimston and Bower, commenced what was really a revolution in gas lighting by utilizing the heat contained in the escaping products of combustion to raise the temperature of the gas and air which are to enter into combination in the flame. An enormous increase in the temperature of the solid particles of carbon in the flame is thereby obtained; and a far greater and whiter light is the result. The Bower lamp, in which, at any rate in the later forms, the flame burns between a downward and an upward current of air, was one of the first produced; and the latest form gives a very high service. As types of the "inverted cone" regenerative burner, we may also take the "Cromartie" and Wenham lamps, which have been followed by a host of imitators; and so closely are the original types adhered to that one begins to seriously wonder what the use of the Patent office really is. The Schulke lamp and one of the latest forms of Siemens regenerative burner, however, stand apart from all the others by dealing with flat and not conical flames, and regeneration is carried to a high degree.

The only drawback to this class of burner is that it is by far the best form of gas stove as well as gas burner, and that the amount of heat thrown out by the radiant solid matter in the flame is, under some circumstances, an annoyance. On the other hand, we must not forget that this is the form of burner best adapted for overhead lighting, and that nearly every form of regenerative lamp can be used as a ventilating agent; and that with the withdrawal of the products of combustion from the air of the room, the great and only serious objection to gas as an illuminant disappears.

When coal gas is burnt the hydrogen is supposed to be entirely converted into water vapor, and the carbon to finally escape into the air as carbon dioxide. If this were so, every cubic foot of gas consumed would produce approximately 0.523 cubic foot of carbon dioxide, and 1.34 cubic feet of water vapor; and the illuminating power yielded by the foot of gas will, of course vary with the kind of burner used.

Roughly speaking, the ordinary types of burner give the following results:

	Illuminating Power in Candles per Cu. Ft. of Gas Consumed.	Products of Combustion per Can. Power.	
		Carbon Dioxide. Cu. Ft.	Water Vapor. Cu. Ft.
Batswing	2.9	0.18	0.46
Argand.....	3.3	0.16	0.40
Regenerative.....	10.0	0.05	0.13

So that the regenerative forms of burner, by giving the greatest illuminating power per cubic foot of gas consumed, yield a smaller amount of vitiation to the air per candle of light emitted. An ordinary room (say 16 ft. by 12 ft. by 10 ft.) would not be considered properly illuminated unless the light were at least equal to 32-candle power; and in the following table the amount of oxygen used up, and the products of combustion formed by each class of illuminant and burner, in attaining this result, are given. The number of adults who would exhale the same amount during respiration is also stated:

Illuminants.	Quantity of Materials Used. Grs.	Oxygen Removed. Cu. Ft.	Products of Combustion.		Adults.
			Water Vapor. Cu. Ft.	Carbon Dioxide. Cu. Ft.	
Sperm Candles ...	3,840	19.27	13.12	13.12	21.8
Paraffine oil.....	1,984	12.48	7.04	8.96	14.9
Gas (London)—					
Batswing burner..	11.0 c.ft.	13.06	14.72	5.76	9.6
Argand	9.7 "	11.52	12.80	5.12	8.5
Regenerative.....	3.2 "	3.68	4.16	1.60	2.6

From these data it appears, according to scientific rules by which the degree of vitiation of the air in any confined space is measured by the amount of oxygen used up and carbon dioxide formed, that candles are the worst offenders against health and comfort, oil lamps come next, and gas least. This, however, is an assumption which practical experience does not bear out. Discomfort and oppression in a room lighted by candles or oil are less felt than in one lighted by any of the older forms of gas burner. The partial explanation of this is to be found in the fact that, when a room is illuminated with candles or oil, people are contented with a feebler and more local light than when using gas. In a room of the size described, the inmates would be more likely to use two candles placed near their books or on a table, than 32 candles scattered about the room. Moreover, the amount of water vapor given off during the combustion of the gas is greater than in the case of the other illuminants. Water vapor, having a great power of absorbing radiant heat from the burning gas, becomes heated, and, diffusing itself about the room, causes a great feeling of oppression. The air also, being highly charged with moisture, is unable to take up so rapidly the water vapor which is always evaporating from the surface of the skin, whereby the functions of the body receive a slight check, resulting in a feeling of *malaise*. Added to these, however, is a far more serious factor, which, up to the present, has been overlooked, and that is that an ordin-

ary gas flame in burning yields distinct quantities of carbon monoxide and acetylene, the prolonged breathing of which in the smallest traces produces headache and general physical discomfort, while their effect upon plant life is equally marked.

Ever since the structure of flame has been noted and discussed, it has been accepted as a fact beyond dispute that the outer, almost invisible zone which is interposed between the air and the luminous zone of the flame is the area of complete combustion; and that here the unburnt remnants of the flame gases, meeting the air, freely take up oxygen, and are converted into the comparatively harmless products of combustion, carbon dioxide and water vapor, which only need partial removal by any haphazard process of ventilation to keep the air of the room fit to support animal life. I have, however, long doubted this fact; and at length, by a delicate process of analysis, have been able to confirm my suspicions. The outer zone of the luminous flame is not the zone of complete combustion. It is a zone in which luminosity is destroyed in exactly the same way that it is destroyed in the Bunsen burner—*i.e.*, the air penetrating the flame so dilutes and cools down the outer layer of incandescent gas that it is rendered non-luminous; while some of the gas sinks below the point at which it is capable of burning, with the result that considerable quantities of the products of incomplete combus ion (carbon monoxide and acetylene) escape into the air and render it actively injurious. I have proved this by taking a small platinum pipe with a circular loop at the end—the interior of the loop being pierced with minute holes; and by making a circular flame burn within the loop, so that the non-luminous zone of the flame just touched the inside of the loop, and then by aspiration, so gentle as not to distort the shape of the flame, withdrawing the gases escaping from the outer zone, and analyzing these by a delicate process which will be described elsewhere, I arrived at the following results:

Gases Escaping from the Outer Zone of Flame.

	Luminous.	Bunsen.
Nitrogen	76.612	80.242
Water vapor	14.702	13.345
Carbon dioxide	2.201	4.966
Carbon monoxide	1.189	0.006
Oxygen	2.300	1.430
Marsh gas	0.072	0.003
Hydrogen	2.388	0.008
Acetylene	0.036	nil.
	100.000	100.000

The gases leaving the luminous flame show that the diluting action of the nitrogen is so great that considerable quantities even of the highly inflammable and rapidly burning hydrogen escape combustion; while the products of incomplete combustion are present in sufficient quantity to perfectly account for the deleterious effects of gas burners in ill-ventilated rooms. The analyses also bring out very clearly the fact that, although the dilution of coal gas by air in atmospheric burners is sufficient to prevent the decomposition of the heavy hydrocarbons, with liberation of carbon, and so destroy luminosity, yet the presence of the extra supply of oxygen does make the combustion far more perfect, so that the products of incomplete combustion are hardly to be found in the escaping gases. These experiments are of the gravest import, as they show, more clearly than has ever been done before, the absolute necessity of special and perfect ventilation where coal gas is employed for the illumination of our dwelling rooms. It must be remembered, however, that these results were obtained with an open flame, and that combustion becomes more and more complete the hotter the flame; so that with regenerative burners the deleterious properties of the escaping products are reduced to a great extent.

When coal gas was first employed, during the early part of this century, as an illuminating agent, the low pitch of the old-fashioned rooms and the excess of the impurities in the gas rendered it imperative that the products of combustion of the sulphur-laden gas should be conducted from the apartment; and for this purpose arrangements of tubes, with funnel-shaped openings, were suspended over the burners. The noxious gases were thus conveyed either to the flue or to the open air. But this type of ventilator was unsightly in the extreme, and some few attempts were made to replace it by a more elegant arrangement, as in the ventilating lamp invented by Faraday, and in the adaptation of the same principle by the late Mr. J. O. N. Rutter, of Brighton, who strove for many years to impress the necessity of removing the products of combustion from rooms. But, with the increase of the gas industry, the methods for purifying the gas became gradually more perfect, while the rooms in the more modern houses were made loftier; and the products of combustion, being mixed with a larger volume of air, and not containing so many deleterious constituents, became, if not much less noxious, at all events less perceptible to the nose.

As soon as this point was reached the ventilating tubes were discarded, and from that day to this the air of our dwelling rooms has been contaminated by our illuminants, with hardly an effort to alleviate the effect produced upon health. I say "hardly an effort," for Messrs. Boyle tried, by their concentric tube ventilators, to meet the difficulty; while M. de la Garde and Mr. Hammond have each constructed lamps more or less on the principle of the Rutter lamp. However, either from their being somewhat unsightly, or from their lowering the amount of light given out, none of them has met with any great success. In places of public entertainment, where large quantities of coal gas are consumed for illuminating purposes, the absolute necessity for special ventilation gave rise to the "sun-burner," with its ventilating shaft. This, however, affords but a poor illuminating power per cubic foot of gas consumed, due partly to the cooling of the flame by the current of air produced, and partly to its distance from the objects to be illuminated. The great difficulty which, in the whole history of ventilation, has opposed itself to the adoption of proper arrangements for removing the products of combustion, has been the necessity for bringing low down into the room the tube intended to carry off the gases, and for encasing the burner in such a way that none of the products should escape. But with the present revolution in gas burners, this necessity is entirely done away with; and the regenerative burner offers the means of not only removing all the products of combustion, but also of effecting thorough ventilation of the room itself, as a ventilating regenerative burner, consuming 20 cubic feet of gas per hour, and, properly fitted, will not only remove all its own products of combustion, but also more than 5,000 cubic feet per hour of the vitiated air from the upper part of the room. The lecturer said he was quite aware that many makers of regenerative lamps did not at all favor the fitting up of ventilating arrangements, which in some cases was a matter of considerable difficulty; but the question was one of such importance, that he trusted the engineering skill which had been so freely displayed in other matters would be extended to this.

Having disposed in a few words of a subject which, if fully treated, would itself occupy a long course of lectures, we will pass on to the consideration of gas as at present used as fuel. There is no doubt that gas is the most convenient, and in many ways one of the best forms of fuel for heating and cooking, and the efforts which all large gas companies are now making to popularize and increase the use of gas for such purposes will undoubtedly bear fruit in the future. But before the day can come for gas to be used in this way on a large scale, there is one fact which the gas manager and gas stove manufacturer must clearly realize and submit to, and that is, that no gas stove or gas water heater of any construction should be sent out or fitted without just as great care being taken to provide for the carrying away of the products of combustion as if an ordinary fuel range was being fitted. Do not for one moment allow yourselves to be persuaded that because a gas stove or a geyser does not send out a mass of black smoke, the products of combustion can be neglected, and with safety be allowed to mingle with the atmosphere to be breathed. Scarcely a winter passes without one or more deaths being recorded from the products of combustion given off from various forms of water heaters used in bath rooms; scarcely a cookery lesson with gas stoves is given without one or more ladies having to leave, suffering from an intense headache, and often in an almost fainting condition. And the cause which brings about these extreme cases, on a small scale gives rise to such physical discomfort to many delicately organized persons, that a large class exist who absolutely and resolutely refuse to have gas as an illuminant or fuel in any of their living-rooms; and if the use of gas, more especially as fuel is to be extended, and if gas is to hold its own in the future, those interested in gas and gas stoves must face the problem, and, by improving the methods of burning and using gas, do away with the serious drawback to its use which now exists.

The feeling has gradually been gaining ground in the public mind, that, when atmospheric burners and other devices for consuming coal gas are employed for heating purposes, certain deleterious products of incomplete combustion find their way into the air; and that this does take place to a considerable extent is shown by the facts brought forward in a paper read by Mr. W. Thomson at the last meeting of the British Association, at Leeds. Mr. Thomson attempted to separate and determine the quantity of carbon monoxide and hydrocarbons found in the flue gases from various forms of gas stoves and burners; but, like every other observer who has tried to solve this most difficult problem, he found it so beset with difficulties, that he had to abandon it, and contented himself with determining the total quantities of carbon and hy-

drogen escaping in an unburnt condition. His experiments proved that the combustion of gas in stoves for heating purposes is much more incomplete than one had been in the habit of supposing; but they did not show whether the incompletely burnt matter consisted of such deleterious products as carbon monoxide and acetylene, or comparatively harmless gases such as marsh gas and hydrogen. After three years of continuous work upon the subject, I have succeeded in doing this by a very beautiful process of analysis which will shortly be made known through the Society of Chemical Industry; and I now wish to lay some of my results before you.

If a cold substance—metallic or non-metallic—be placed in a flame, whether it be luminious, or non-luminous, it will be observed that there is a clear space, in which no combustion is taking place, formed round the cool surface, and that, as the body is heated, this space becomes gradually less, until, when the substance is at the same temperature as the flame itself, there is contact between the two. Moreover, when a luminous flame is employed in this experiment, the space still exists between the cool body and the flame; but it will also be noticed that the luminosity is decreased over a still larger area, though the flame exists. This means that in immediate contact with the cool body, the temperature is so reduced that a flame cannot exist, and so is extinguished over a small area; while over a still larger space the temperature is so reduced that it is not hot enough to bring about decomposition of the heavy hydrocarbons, with liberation of carbon, to the same extent as in hotter portions of the flame. Now, inasmuch as, when water is heated or boiled in an open vessel, the temperature cannot rise above 100° C., and as the temperature of an ordinary flame is more than 1,000° C., it is evident that the burning gas can never be in contact with the bottom of the vessel; or, in other words, the gas is put out before combustion is completed, and the unburnt gas and products of incomplete combustion find their way into the air, and render it perfectly unfit for respiration. The portion of the flame which is supposed to be the hottest is about half an inch above the tip of the inner zone of the flame. It is at this point that most vessels containing water to be heated are made to impinge on the flame; and it is this portion of the flame also that is utilized for raising various solids to a temperature at which they will radiate heat in most forms of gas stove.

In order to give an insight into the amount of contamination which the air undergoes when a geyser or a cooking stove is at work, I have determined the composition of the products of combustion and the unburnt gases escaping when a vessel containing water at the ordinary temperature is heated up to boiling point by a gas flame, the vessel being placed in the first case half an inch above the inner cone of the flame, and in the second at the extreme outer tip of the flame. The results are given in the following table:

Gases Escaping During Checked Combustion.

	Bunsen Flame.		Luminous Flame.	
	Inner.	Outer.	Inner.	Outer.
Nitrogen	75.75	79.17	77.52	69.41
Water vapor	13.47	14.29	11.80	19.24
Carbon dioxide	2.99	5.13	4.93	2.38
Carbon monoxide	3.69	nil.	2.45	2.58
Marsh gas	0.51	0 31	0.95	0.39
Acetylene	0.04	nil.	0.27	nil.
Hydrogen	3.55	0.47	2.08	nil.
	100.00	100.00	100.00	100.00

These figures are of the greatest interest, as they show conclusively that the extreme tip of the Bunsen flame is the only portion which can be used for heating a solid substance without liberating deleterious gases. This corroborates the previous experiment on the gases in the outer zone of a flame, which showed that the outer zone of the Bunsen flame is the only place where complete combustion is approached. Moreover, this work sets at rest a question which has been over and over again under discussion, and that is whether it is better to use a luminous or a non-luminous flame for heating purposes. Using a luminous flame, it is impossible to prevent a deposit of carbon, which is kept by the flame at a red heat on its outer surface; and the carbon dioxide formed by the complete combustion of the carbon already burnt up in the flame, is by this reduced back to carbon monoxide. So that even in the extreme tip of a luminous flame it is impossible to heat a cool body without giving rise to carbon monoxide, although, acetylene being absent, gas stoves in which small flat-flame burners are used have not that subtle and penetrating odor which marks the ordinary atmospheric burner stove with the combustion checked just at the right spot for the formation of the greatest volume of noxious products. It is the contact of the body to be heated with the flame before combustion is complete that gives rise to the great mischief. Any cooling of the flame extinguishes a portion of it; and the gases present in it at the moment of extinction creep along the cooled surface and escape combustion.

Dr. Blochmann has shown the composition of the gases in various parts of the Bunsen flame to be as follows:

Height above Tube.	In Tube.	1 in.	2 in.	3 in.	Complete combustion.
Air with 100 vols. of gas	253.9	284.7	684.5	484.3	608.8
Hydrogen	48.6	36.4	17.7	16.1	nil.
Marsh gas	39.0	40.1	28.0	5.7	nil.
Carbon monoxide	2.9	2.2	19.9	12.7	nil.
Olefiant gas	4.0	3.4	2.2	nil.	nil.
Butylene	3.0	2.5	1.6	nil.	nil.
Oxygen	50.7	52.0	21.7	nil.	nil.
Nitrogen	199.8	223.8	225.9	382.4	432.3
Carbon dioxide	0.3	3.5	18.0	41.7	62.4
Water vapor	3.1	11.8	45.3	116.1	140.2

This shows that it would be impossible to check the flame anywhere short of the extreme tip (where complete combustion is approximately taking place) without liberating deleterious products.

In utilizing a flame for heating purposes combustion must be completed before any attempt is made to use the heat, in other words, the products of combustion and not the flame must be used for this purpose.

I think I have said enough to show that no geyser or gas stove should be used without ample and thorough means of ventilation being provided; and no trace of the products of combustion should be allowed to escape into the air. Until this is done the use of improper forms of stoves will continue to inflict serious injury on the health of the people using them; and this will gradually result in the abandonment of gas as a fuel, instead of, as should be the case, its coming into general use. The English householder is far too prone to accept what is offered to him without using his common sense; and he will buy the article which pleases his eye the most, and affects his pocket the least, on the bare assurance of the shopkeeper who is only anxious to sell. But when he finds his health and comfort are in jeopardy, he discards the gas stove; and when he has done so, it will take years of labor to convince him that it was the misuse of gas which caused his trouble. Already signs are not wanting that the users of gas stoves are beginning to fight shy of them; and I earnestly hope that the gas managers of the Kingdom will bring pressure to bear upon the stove makers to give proper attention to this very serious question. So strongly do I feel its great importance to the gas world and the public at large that I freely offer to analyze the products of combustion given off by any gas stove or water heater sent to me at Greenwich during the next six months; but on one condition—namely, that the results, whether good, bad or indifferent, are to be published in a paper to be read before the Society of Arts, which has always been in the front when matters of great sanitary importance to the public have had to be taken up. If, after that, the public like to buy forms of apparatus which have not been certified, it is their own lookout; but I certainly do think that the maker of any stove or geyser which causes a death should be put upon his trial for manslaughter.

Let us now consider for a moment what is likely to be the future of gas during the next half century. The labor troubles, bad as they are and have been, will not cease for many a weary year. The victim of imperfect education—more dangerous than none at all, as, while destroying natural instinct, it leaves nothing in its place—will still listen to and be led by the baneful influence of irresponsible demagogues, who care for nothing so long as they can read their own inflammatory utterances in the local press, and gain a temporary notoriety at the expense of the poor fools whose cause they profess to serve. The natural outcome of this will be that every possible labor-saving contrivance will be pressed into the gas manager's service, and that although coal (of a poorer class than that now used) will still be employed as the source of gas, the present retort setting will quickly give way to the inclined retorts on the Coze principle; while instead of the present wasteful method of quenching the red-hot coke, it will, as far as it can be used, be shot direct into the generator of the water gas plant, and the water gas, carbureted with the benzene hydrocarbons derived from the smoke of the blast furnaces and coke ovens, or from the creosote oil of the tar distiller, by the process foreshadowed in the concluding sentences of the preceding lecture, will then be mixed with the gas from the retorts, and will supply a far higher illuminant than we at present possess. In parts of the United Kingdom such as South Wales, where gas coal is dear and anthracite and bastard coals are cheap, water gas, highly carbureted, will entirely supplant coal gas, with a saving of 50 per cent. on the prices now existing in these districts.

While these changes are going on, and improved methods of manu-

facture have been tending to the cheapening of gas, it will have been steadily growing in public favor as a fuel ; and if, in years to come, the generation of electricity should have been so cheapened as to allow the electric light to successfully compete with gas as an illuminant, the gas works will still be found as busy as of yore, and the holder of gas shares as contented as he is to-day ; for, with the desire for a purer atmosphere and white mist instead of yellow fog, gas will have largely supplanted coal as a fuel, and gas stoves, properly ventilated and free from the reproaches I have hurled at them to-night, will burn a gas far higher in its heating power than that we now use, far better as regards its capacity for bearing illuminating hydrocarbons, and entirely free from poisonous constituents. As soon as the demand for it arises, hydrogen gas can be made as cheaply as water gas itself; and when the time is ripe for a fuel gas for use in the house, it is hydrogen and not water gas that will form its basis.

With carbureted water gas and 20 per cent. of carbon monoxide, we shall still be below the limit of danger; but a pure water gas, with more than 40 per cent. of the same insidious element of danger, will never be tolerated in our households. Already a patent has been taken by Messrs. Crookes and Ricarde-Seaver for purifying water gas from carbon monoxide, and converting it mainly into hydrogen by passing it at a high temperature through a mixture of lime and soda lime—a process which is chemically perfect, as the most expensive portion of the material used could be recovered. In the present state of the labor market, however, it is not practical, as, for the making of every 100,000 cubic feet of gas, 15 tons of material would have to be handled. The cost of labor alone would thus be sufficient to prevent its being adopted, and, moreover, hydrogen can be made directly far cheaper.

From the earliest days of gas making, the manufacture of hydrogen by the passage of steam over red-hot iron has been over and over again mooted and attempted on a large scale ; but several factors have combined to render it futile. In the first place, for every 478.5 cubic feet of hydrogen made under perfect theoretical conditions never likely to be obtained in practice, 56 lbs. of iron were converted into the magnetic oxide; and as there was no ready sale for this article, this alone would prevent its being used as a cheap source of hydrogen. The next point was that, when steam was passed over the red-hot iron, the temperature was so rapidly lowered that the generation of gas could only go on for a very short period. Finally, the swelling of the mass in the retort, and the fusion of some of the magnetic oxide into the side, renders the removal of the spent material almost an impossibility. These difficulties can, however, be overcome. Take a fireclay retort 6 feet long and 1 foot in diameter, and cap it with a casting bearing 2 outlet tubes closed by screw valves, while a similar tube leads from the bottom of the retort. Enclose this retort, set on end, by a furnace chamber of iron, lined with firebrick, leaving a space of 2 feet 6 inches round the retort ; and connect the top of the furnace chamber with 1 opening at the top of the upright retort, while an air blast is led into the bottom of the furnace chamber below rocking fire bars, which start at the bottom of the retort and slope upwards to leave room for ash holes closed by gas-tight covers. The retort is filled with iron or steel borings—alone if pure hydrogen is required, or cast into balls with pith if a little carbon monoxide is not a drawback, as in foundry work. The furnace chamber is filled with coke, fed in through manholes or hoppers in the top; and the fuel being ignited, the blast is turned on, and the mixture of nitrogen and carbon monoxide formed passes over the iron, heating it to a red heat, while the incandescent coke in contact with the retort does the same thing. When the fuel and retort full of iron are at a cherry red heat, the air blast is cut off, and the pipe connecting the furnace and retort, together with the pipe in connection with the bottom of the retort, is closed. Steam, superheated by passing through a pipe led round the retort or interior wall of the furnace, is injected at the bottom of the red hot mass of iron, which decomposes it, forming magnetic oxide of iron and hydrogen, which escape by the second tube at the top of the retort, and are led away—to a carbureting chamber if required for illumination, or else direct to the gasholder if wanted as a fuel ; the mass of incandescent fuel in the furnace chamber surrounding the retort keeping up the temperature of the retort and iron sufficiently long to enable the decomposition to be completed. The hydrogen and steam valves are now closed, and the air blast turned on ; and the hot carbon monoxide, passing over the hot magnetic oxide, quickly reduces it down again to metallic iron, which, being in a spongy condition, acts more freely on the steam during later makes than it did at first, and, being infusible at the temperature employed, may be used for a practically unlimited period. What more simple method than this could be desired ? Here we have the formation of the most valuable of all fuel gases at the cost of the coke and steam used—a gas also which has double the carrying power for hydrocarbon vapors possessed by coal gas, while its combustion gives rise to nothing but water vapor.

In this course of lectures I have left much unsaid and undone which I should like to have had time to accomplish ; and if I have been obliged to leave out of consideration many important points, it is the time at my disposal, and not my desire, which is to blame. In bringing them to a conclusion, I wish to express my thanks to my assistants, Messrs. J. A. Foster and J. B. Warden, who have heartily co-operated with me in the preparation of the original portion of the matter I have brought before you ; and I now leave the criticism of the lectures in your hands, hoping you will see in them an earnest desire to do my mite in advancing the most useful industry the country possesses.

In illustration of the portion of the lecture dealing with gas burners, several of the latest types of regenerative lamps were shown in action, and described by Professor Lewes, to whom a hearty vote of thanks was accorded, on the proposition of the Secretary of the Society (Sir Henry Trueman Wood), for the able way in which he had treated the important subject selected for the first course of Cantor Lectures for the session.

The Petroleum Market for 1890.

Messrs. Watson & Gibson, of New York, have prepared for a contemporary the following review of the petroleum market for the past year.

The petroleum market for the year 1890 has been marked by almost continued dullness. The speculative spirit which a few years ago was rampant appears to have entirely vanished from the Exchanges.

The market in January, 1890, was about 35 to 34 cents higher than it is at present for National Transit certificates, but the fall in value has been gradual and not attended by any excitement. The gross stock on hand has been reduced from nearly 11 million to about 8 million barrels during the year. The operations in the field have been large and the demand has been fully maintained, and there are no signs of a loss of the European market on account of any Russian competition.

The most important events of the year were the introduction of dealings in Ohio oil late in the summer, the great disappointment of the trade over the course of prices for the Ohio product, and the failure of speculation to take an active hold of it. The first transactions in Lima oil were made at about 40 to 42 cents per barrel, but the activity which marked the earlier dealings around these figures soon gave way to a gradually falling price, which reached as low as 14 cents in November—and days passed without a single transaction. Accompanying the fall in Ohio oil, there was an absorption by the Standard Oil Trust of independent refineries at Lima and Findlay, and the year ends with its power more absolute in the oil trade than ever before. The price of Ohio oil at the end of the year is nominally about 18 cents on the Exchanges, but it must be borne in mind that a purchase at this price does not put the buyer in possession of the actual commodity, because he has to pay (as is also true of Pennsylvania oil) an additional charge of 20 cents pipeage to the Standard Transportation and Pipe Line Company, called the Buckeye, for delivery of this oil at some tank or railway station. The addition of an increase of 20 cents to the price of the Ohio oil makes a larger relative cost as compared with Pennsylvania oil than 20 cents in the higher price of the Pennsylvania product.

Relatively we think the Ohio oil is cheaper, and it is no longer denied (as we have for many years asserted as a fact) that the Ohio oil can be successfully refined. It is also true, however, that the percentage of illuminating fluid obtained from the Ohio crude is considerably less than from the Pennsylvania. There is one trouble, however, with the Pennsylvania oil dealt in on the Exchanges, namely, it is old oil, and much deteriorated by age. The Standard has for several years been paying a premium on all the new oil coming from the white sand districts, which are most prolific in Pennsylvania, and thus the mass of oil in the custody of the National Transit Company has not been enriched by the addition of any new production.

The stock of Buckeye oil at present on top of ground is about 20 million barrels, against, say, 8 millions of Pennsylvania oil. It was expected that when Ohio oil was listed a great deal of speculation would take place in it, and that the Standard would be interested in stimulating it; and it was also a common belief that, with a view to unloading some of it on the public, the Standard—for the Company had it all—would put up the price to invite, as higher prices generally do invite, outside buying. This proved to be a false theory, and the market fell below any prices to which the most radical bear had predicted it would go. An exchange was established in Lima and in Findlay and in Toledo, but they all failed completely and have been abandoned. During the year the Pittsburgh Oil Exchange has sold its building, and has gone into

more modest and inexpensive quarters, and the year of 1890 in the petroleum market ends without the slightest interest on the part of the public in the fluctuations or statistics of production and consumption. The public has literally been "frozen out," and it would not be easy to excite any renewed interest in a business which has been concentrated absolutely in the hands of the most successful financial corporation on this continent.

It is perfectly idle for any individual to attempt to make money out of a game wherein he and his confreres can have no possible show to win except by the mere, blind chance, and we see no reason to expect that the year 1891 will bring any change in this respect unless the wells in Ohio, which during the past 12 months have proven to be very prolific, should show signs of material exhaustion. When that period does arrive, as it doubtless will in the course of time, and the production of petroleum on this continent fails or threatens to fail, without hope of being replenished by any new field in sight, "then, and not till then," will there be hope for any outside ventures of consequence in the demand of petroleum speculation.

Fluctuation in Prices per Barrel (40 Gals.) of Petroleum During 1890.

(Consolidated Stock and Petroleum Exchange.)

Months.	Opening.	Highest.	Lowest.	Closing.	Sales.
January	103	107⅝	102⅝	103⅝	7,122,000
February	105¾	108	97⅞	99	4,979,000
March	97¾	98¾	83⅞	84	6,142,000
April	81⅝	85½	79⅝	84½	5,545,000
May	85½	96½	84	89⅞	5,597,000
June	90½	91⅞	85⅞	86	3,330,000
July	86⅞	90⅝	86⅜	88½	1,738,000
August	89⅜	93¾	82¾	83½	2,452,000
September	84	85	77	77	1,951,000
October	80½	82⅜	76	76	1,409,000
November	78½	81	67	67⅞	434,000
December	67¼	72	60½	70⅜	1,703,000
Year	103	108	60½	70⅜	40,699,000

(New York Stock Exchange.)

Months.	Opening.	Highest.	Lowest.	Closing.	Sales.
January	102⅝	108¼	102½	104½	5,146,000
February	105⅜	107⅝	98	99⅜	2,977,000
March	98⅞	99½	84	84½	3,218,000
April	84¾	85¼	79½	84½	3,350,000
May	85¼	96½	84½	89	2,240,000
June	90⅜	91⅞	85	85¾	2,027,000
July	86	90⅜	85⅞	88	931,000
August	88	93½	83	83½	1,052,000
September	83¼	84½	78	78	1.036,000
October	78½	82¾	76	76½	535,000
November	78½	79¾	65⅞	66½	1,024,000
December	66⅜	71⅞	63¾	70¼	533,000
Year	102⅝	108¼	65¾	70¼	24,069,000

The Manufacture of Oxygen from the Air.

Charles A. Kohn, Ph.D., writing of the manufacture of oxygen from the air, says: Air contains 23 per cent. of oxygen by weight, and nearly 21 per cent. by volume, and considering that the prime cost of this raw material for the manufacture of oxygen is nil, it is not surprising that numerous attempts have been made to obtain oxygen from this source. The Patent Office of England has granted no less than 24 patents with this object in view, dating from 1852, when Swindels and Nicholson (Eng. Pat. 390, 1852) first proposed to utilize Boussingault's discovery for the preparation of oxygen from air by the alternate oxidation and reduction of the oxides of barium. It is this process which today, in the hands of the Brin Oxygen Company, has proved the most successful means to obtain oxygen from the atmosphere; but, before considering it, it will be well to pass in review the principles involved in the most important of the other processes which have been suggested. Mallet's process, which was patented in 1865, was to expose cuprous chloride to moist air, when cupric-oxy-chloride is formed, and this, when heated to a dull red heat, evolves oxygen and regenerates the cuprous chloride ready for a second oxidation, as before. In 1866, Tessie du Motay and Marechel brought out their method, which consisted in heating black oxide of manganese and a strong base, such as caustic soda, in a current of air, when a manganate—a compound of the oxide of manganese and the base is formed. This, on further heating in a current of super-heated steam, is decomposed, oxygen is given off, and a mixture of the oxide of manganese and the base left behind, which can again be converted into the manganate, this process, like that of Mallet's, being a continuous one. The patents connected with this method were taken up by several companies, both on the Continent and in New York, but these, after a short-lived glory, during which period oxygen was sold at the price of 1s. 10d. per cubic foot, seem to have come to an untimely end. It is well known that the air dissolved in water is richer in oxygen than ordinary atmospheric air—a fact due to the greater solubility of oxygen, as compared with that of nitrogen, the other constituent of the atmosphere. By extracting the air thus dissolved by means of a vacuum pump, dissolving it again in water and repeating the process three or four times, the resulting mixture becomes highly oxygenized, containing as much as 75 per cent. of the pure gas. Several attempts to make use of this property of air have been made with the view of utilizing it for the industrial manufacture of oxygen, but they have not been attended with any degree of success.

A process somewhat resembling that of Tessie du Motay's has recently been patented by G. Kassner (Eng. Pat. 11,899, 1889), in which oxide of lead is heated in contact with the carbonate of lime, barium, or stratium, preferably the first of these, and the resulting body—calcium plumbate—decomposed by means of sodium bicarbonate. Sodium carbonate is formed, which can be recovered, whilst the residual mass when dried and heated evolves oxygen. The gas is evolved at a conveniently low temperature, whilst the mixture of oxide of lead and carbonate of lime can be again subjected to the initial treatment, and it is said to remain practically unaltered through a long series of operations. The success of all these processes depends essentially upon their continuity, and this continuity itself depends upon the extent to which the initial product employed remains unchanged throughout a long series of operations. The tendency of the substances employed to become inactive, after having passed through the cycle of changes several times, has always been the stumbling block in the way of the achievement of a thoroughly sound method for getting oxygen from the air. This refers especially to Boussingault's barium oxide method, which from its beautiful simplicity when in the form of a laboratory experiment, has long been regarded as the means *par excellence* for the attainment of the end in view. But it is well known that "there's many a slip 'twixt" the successful laboratory experiment and the realization of the same as a remunerative commercial process; and whilst it may be readily shown that barium oxide when tested in a current of air absorbs oxygen to form a dioxide, and that this on further heating evolves the oxygen it has taken up with the regeneration of the original product, it is only since 1880, or 29 years after the actual discovery of these reactions, that the possibility of conducting them with an adequate prospect of success has been realized. It has been in the hands of A. and L. Q. Brin that this relization has been effected, and their original method (English Patent 1,416, 1880), which has undergone several improvements and modifications, is now being worked by the Brin Oxygen Co., of London. The difficulties that Messrs. Brin had to contend with were of a mechanical rather than of a chemical nature, especially in regard to the physical condition of the oxide of of barium employed and the necessity of thoroughly purifying the air used; otherwise the baryta soon becomes inactive, and the process no longer a continuous one.

The baryta employed to-day is obtained by the ignition of barium nitrate, when it is got in a porous condition specially suited for the absorption of oxygen. This is packed in pieces about the size of a walnut into wrought iron, or preferably steel, cylinders about 10 feet long and 8 inches wide, heated in a suitable gas furnace. The retorts, which hold about 125 lbs. of baryta, are closed at each end by a gun metal lid, from the center of each of which a gun metal pipe passes from each retort to the one next to it, a series of 6 being connected up in this way, so that the air which enters at one end of the series passes out at the other. Several series of retorts, which are placed in a vertical position, can be heated by one and the same furnace. The air, previously purified from carbon dioxide and moisture by passing over layers of quicklime and caustic soda, is forced through the retort by means of pumps, the retorts being maintained at a faint red heat (600° C.). When the absorption is complete the temperature is raised to about 800° C., the pumps reversed, and the oxygen, which is then liberated, drawn off and led to the gas holder, where it is stored previous to its being pumped into cylinders for transportation. The whole operation occupies about 4 hours, and yields about 0.7 cubic feet of oxygen per pound of baryta employed. A great improvement has been effected in the original form of the apparatus as described by dispensing entirely with the raising of the temperature to drive off the absorbed oxygen. It has been found that by keeping the temperature constant throughout the whole operation (at about 700° C.) the absorbed oxygen can be liberated by simply exhausting the retorts by

means of the pumps. The air is forced in under a pressure of 15-20 lbs. on the square inch, and when the absorption is complete the pumps are reversed as before and the oxygen drawn off by means of a vacuum. The yield of oxygen by this means is only 0.1 cubic foot per pound of baryta employed, or one-seventh of the yield obtained in the previous form of the process; but, on the other hand, the whole operation can be carried out in 10 to 15 minutes, whilst the saving of labor and the decreased wear and tear of the apparatus make it, on the whole, a decided improvement on the older method. The price of the oxygen thus prepared must vary according to the prices of labor and of fuel in the locality in which it is produced. In London it can be manufactured for 7s. 6d. per 1,000 cubic feet, and in more favorably situated centers, this figure should be capable of reduction to at least 5s., so that we can consider that the manufacture of oxygen from the air has, without a doubt, passed from the condition of a scientific experiment into the region of industrial enterprise.

The Mechanical Engineer.

[Synopsis of a response to the toast, "The Mechanical Engineer," delivered by Mr. Wm. Enfield, of the Dallas City, Texas, Gas Light Company, at the Second Annual Banquet of the Association of Civil Engineers, Dallas, Texas, Jan. 9, 1891.]

Nothing characterizes the professional man of to-day so much as boldness. He is not only a man of design and originality, but a man of resources. Back him with capital, and the necessary intelligence, foresight, elaboration and pluck are at his finger's end, and to command. The United States is to-day the most complete hotbed for the propagation and forcement of professional men, and the familiar word "front" can well be imagined, if not distinctly heard.

The Civil Engineer, proper, naturally takes precedence, but close upon his heel comes the Mechanical Engineer. I fancy I hear the latter calling to his natural leader and forerunner: "Lead on, noble pioneer; delineate your plans; lay down your contours; establish your levels and mark your bounds, and we will implicitly follow with our bridges, our metallic lines, our cities, our factories, our gas and water works, and all the solid and minor details which constitute the foundation for, and the throbbing human activity of a busy and energetic commercial life.

The Mechanical Engineer, like all professional men, is little to the average commonwealth but a man with a trade; but to his brother professionals he is the embodiment of power, intelligence, and finesse. It is his business to travel unexplored paths, to surmount difficulties, to improvise means, and to achieve the hitherto impossible. A bridge must cross where viaducts have hitherto been considered impracticable; power must be transferred where only dynamos and wires can supply the means; a locomotive must be made to climb a hill where a railroad was considered impracticable; waste products must be utilized and turned to commercial value by means of mechanism to be resolved from the brain; the duty of a pound of coal ten years ago must be increased by 25 per cent.; perfect combustion is to be the rule of to-day, and waste must be eliminated; lightning must be chained within the bounds of dynamos and their circuits, and thunder must drive the pistons of gas engines.

Our perfect machinery of ten years ago is perfected to a higher type by that of to-day, and who will be cowardly enough to say that the end is *now*? Statics, hydraulics, pneumatics, and all the "atics" of now and the future shall be invoked to aid the resources of the Mechanical Engineer; he shall rotate, gyrate, elongate, pendulate, oscillate, contrifugate and centripitate; his home shall be the earth, the air, the mountain, the plain; and last, but not least, the deep blue sea.

He shall be a crank and an eccentric, shall toe the line or fly of on a tangent at will. Give him rope, gentlemen, and I am sure he will not hang himself, but rather will he make a shift (sheave) wheel and transfer his powers.

This, gentlemen, is he who designs the thing of beauty which is also a tower of strength. He deals in mind and matter, also in weighty things,—some are married, with children (others have not turned their mechanical genius that way). At home you will see them lay aside the weighty engine, the cumbersome bridge, the mammoth gasometer, and gently take up baby's toy to replace a wheel, or adjust mamma's sewing machine. On the bridge, ships, engines or locomotives he weighs carefully the strains, the contraction and expansion because he knows full well the head and the hand of the engineer must be supplemented by the engineer's heart.

MR. G. R. MELVILLE has been appointed Manager of the Galena (Ills.) Gas Light Company.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

THE following letter explains itself:

"HARTFORD, CONN., Jan. 19, 1891.

To the Editor AMERICAN GAS LIGHT JOURNAL: Your notice that I had, with associates, petitioned for charters in several cities of Connecticut needs some explanation. Our Legislature only meets once in 2 years, and, to put pipes in the streets, permission has to be obtained from that body. As several manufacturers in each city have been investigating with the intention of building individual plants, it was thought best to build one plant for the whole, as gas could in that way be made much cheaper. In doing this we are not interfering with or taking away business from any one else. The furnishing of fuel for gas manufacturing purposes is a new field—one waiting to be worked; and to compete and keep up with the times is demanded by the manufacturers of all metal goods. My success in this line has been very satisfactory, and I can now make and deliver a very cheap fuel gas, which, with the various devices we now have for using gas economically, brings it in competition with coal direct. Yours respectfully, BURDETT LOOMIS."

AT the annual meeting of the shareholders in the Dayton (O.) Gas Light and Coke Company, the following Directors were elected: Messrs. R. R. Dickey, H. C. Graves, Joseph Clegg, W. P. Callahan, Simon Gebhart, John Harrick, J. K. McIntire, C. B. Oglesby and J. A. McMahon. The Company's business has outgrown the present plant, and the shareholders decided to issue $30,000 of new stock, the proceeds to be expended on plant betterment.

AT the annual meeting of the Chicago Gas Light and Coke Company the following resolutions were unanimously adopted:

"*Whereas*, Charles T. Yerkes, Esq., has voluntarily retired from the Presidency of the Chicago Gas Light and Coke Company, now, therefore, be it

"*Resolved*, That the efficient and able management of the affairs of the Company by Mr. Yerkes, and without remuneration from this Company for his services, commend his administration to the stockholders and the bondholders, whose interests he has so well subserved and whose property he has so faithfully protected.

"*Resolved*, That the thanks of this Board are hereby tendered to Mr. Yerkes for the prudential care that he has displayed and for the wise and efficient management that has marked his career as President of the Company.

"*Resolved*, That a copy of these resolutions be spread upon the minutes of the Company."

AT the annual meeting of the Hackensack (N. J.) Gas Company the following Directors were chosen: W. S. Banta, Geo. W. Wheeler, John A. Grode, Wm. Huyler, E. E. Poor, Walter V. Clark and Geo. W. Conklin.

AN odd accident is reported from Pottsville, Pa., where, some days ago, a flat freight car, loaded with a heavy boiler, in passing over the Mauch Chunk street bridge, was the cause of demolishing the gas main that passed underneath the bridge footway.

THE new electric light station at Norwalk, Conn., will be built by the Berlin Iron Bridge Company, of East Berlin, Conn., from that Company's own designs. The building will be 60 ft. by 70 ft., and will have a two-ton traveling crane extending the whole length of the building. The construction will be entirely of iron, fireproof, and is expected to be a model station of the kind.

AT the annual meeting of the stockholders in the Williamsport (Pa.) Gas Company the following officers were chosen: President, Hon. Joseph M. Gazzam; Secretary, Treasurer and Superintendent, C. A. Byers; Asst. Superintendent, M. J. Winters; Solicitor, John G. Reading, Jr.; Directors, B. C. Bowman, Dr. Alvin G. Hill, C. M. Lawler, H. Mudge, Joseph M. Gazzam, H. W. Watson and John G. Reading, Jr.

THE works of the Spencer (Mass.) Gas and Electric Light Company were badly damaged by fire about a fortnight ago, and gas was cut off from the town for some days. The loss is put at $5,000. The plant will be restored at once. The Spencer Company has been very unfortunate in respect to fires, in that this is the second time within three years that its works were closed because of the work of the flames.

A LOUISVILLE, Ky., correspondent, writing under date of the 17th inst., says: "The completion of the new works of the New Albany (Ind.) Gas Light and Coke Company is announced, and that fact is fol-

lowed by the management with the further announcement of a no less substantial and satisfactory character, that from and after February 1st the selling rate is to be cut to $1.50 per 1,000 cubic feet, a reduction of 25 per cent. from the price which the Company is permitted to charge under its new charter. The capacity of the new works is four times as great as the present output, also there is small room to doubt that the new selling rate will greatly reduce the disparity between size of plant and output. The electric annex of the Company has also been greatly enlarged and improved, and it will, on and after February 1st be in position to furnish current to any desired number of arc or incandescent lamps. The rate for arc lamps, on commercial lines, has been reduced to $6 per month, lights to be extinguished at midnight. This rate is a concession of 25 per cent. over that formerly in vogue. I am unable to state at this time what the incandescent electric service will be scheduled at, but I do not believe that the system will find favor with the people.—F. G. R."

AT the annual meeting of the Saginaw (Mich.) Gas Company the following Directors were chosen: W. L. Webber, H. C. Potter, G. W. Morley, E. W. Morley and H. P. Smith. The Directors organized by naming the following officers: President, W. L. Webber; Vice-President, H. C. Potter; Treasurer, G. W. Morley; Secretary, H. P. Smith; Superintendent, G. A. Hyde, Jr.

THE proprietors of the Worcester (Mass.) Electric Light Company have perfected their executive organization for the year. Mr. T. M. Rogers was re-elected President, and W. H. Coughlin will continue to act as Superintendent. The business was fairly prosperous last year.

THE Associated Press reports that on the afternoon of the 11th inst. John T. C. Reiny, a workman in the employ of one of the electric lighting companies of Boston, Mass., while replacing a burned out incandescent electric lamp with a sound one, received a shock that killed him instantly. His grasp on the globe and wire was so firm that the latter had to be cut before it could be removed from his hand.

DIRECTOR WAGNER has issued the following statement respecting the quantity of gas manufactured in the Philadelphia municipal gas works in 1890; also a resume of the receipts and expenditures for that period in comparison with 1889:

Receipts.		Expenditures.	
1890....	$3,659,644.20	1889....	$2,851,019.51
1889....	3,658,224.83	1890....	2,766,267.67
Increase	$1,419.37	Decrease	$84,751.84

Make of Gas.

1890.....	3,311,995,000 cubic feet.
1889.....	3,151,156,000 "
Increase.....	160,839,000 "

	1890.	1889.
Profits.....	$893,376.53	$807,205.32
Free gas for city lighting	862,810.31	820,499.40
Total profit.....	$1,756,186.84	$1,627,704 72

Profits.

	Cash.	Gas Used in City Lighting.	Total.
1890.....	$893,376.53	$862,810.31	$1,756,186.84
1889.....	807,205.32	820,499.40	1,627,704.72
Increase,'90	$86,171.21	$42,310.91	$128,492.12

Comparative statement of gas furnished to departments by the Bureau of Gas for which no charge was made:

	1889.	1890.
Bureau of Police	10,905,900 cu. ft.	13,404,300 cu. ft.
" Fire..	7,099,800 "	8,698,500 "
" Water	2,458,100 "	2,419,300 "
Public buildings	12,716,500 "	19,821,600 "
Almshouse.....	12,782,200 "	14,275,600 "
City property..	5,427,200 "	4,957,400 "
Public squares..	7,543,206 "	7,376,802 "
Park Commis'n.	498,500 "	338,700 "
Public schools..	6,636,500 "	7,764,400 "
Street lamps....	455,423,195 "	472,402,970 "
Used at works, etc.	25,598,500 "	23,747,300 "
Total.....	546,999,601 "	575,206,872 "
	At $1.50.	At $1.50.
	$820,499.40	$862,810.31

Increase in 1890, 28,207,271 cubic feet, at $1.50 per 1,000, equal in value to $42,310.91.

THE election for Directors in the New Orleans (La.) Gas Light Company was held on the 13th inst., when the following Board was chosen: A. H. Sieverd, R. M. O'Brien, James Jackson, S. H. Kennedy, Alden McLellan, A. Baldwin and F. F. Howard. The Company enjoyed a very prosperous year, and it is likely that important plant betterments will be made this spring.

AT the annual meeting of the Manchester (N. H.) Electric Light Company, the President, Mr. Alonzo Elliott, made a good, commonsense report, in which it was shown that though the Company had been managed on a most conservative basis, and that though no means has been neglected to cause ends to meet, it was nevertheless a fact that the net earnings were not large enough to warrant the declaration of a dividend. To use a portion of the report as it came from the President: "It must be borne in mind that the rates received for lighting this city are low compared with those paid for a like service in other cities similarly situated, it is only with the strictest economy in labor and fuel consumption that the business can be made to return a fair interest on the capital of over $175,000 now invested." It may not be uninteresting in this connection to note that the Manchester Electric Lighting Company's interests are not in any sense inimical to those of the local People's Gas Light Company.

MUCH speculation has been indulged in as to the reasons that led to the retirement or withdrawal of Messrs. S. A. Kent and "Nickel Plate" Cummings from the Directorate of the Chicago Gas Light and Coke Company, but we imagine that the changes are due to those very simple reasons that may be summed up in the words, they sold their stock, and so were not entitled to any voice in the management. They have all along been obstructionists; further they are not conversant with the business, else they would not now be dabbling in the shares of the Chicago concern, known as the Economic Fuel and Gas Company, newly ordained by the Common Council and other executives of the Windy City. Of course, there might be something in this for the "Nickel Plater" and his friends if the Economic Company managed eventually to "parallel" the old Chicago Company in the matter of supplying an illuminating gas; but only in that event. There is no profit in the sale of an essentially fuel gas, even in Chicago, where almost anything can be sold—and bought. The failure of Mr. C. T. Yerkes to a re-election for the presidency of the old Company need occasion no surprise. He manfully stood in the breach when that opening looked formidable, and now that the Company's business affairs are in good shape he can follow the bent of his mind and retire with honor from a position which was never very much to his liking. To all this it may be added that his holdings in the Company are not as large as they were. In the meantime it might be remarked that Mr. Billings retains his old place of Vice President, and the indications are that M. le Baron Jerzmanowski will find in Mr. Billings an alert and remarkably apt understudy.

THE proprietors of the Wallingford (Conn.) Gas Light Company are considering the advisability of installing and operating an electric lighting plant.

MR. MORRIS, of the Tennessee Senate, has presented to that body a memorial from the Committee appointed by the City Council of Nashville asking for leave to issue bonds for the purchase or erection of a gas plant, and asking that it confer upon the city the power to manufacture and furnish the city and citizens with gas at as low a price as is consistent with the judicious management.

THE same Senator also offered a bill authorizing municipal corporations to issue bonds for the building and equipping or purchasing of gas plants and systems of gas works, and to secure payment of all such bonds.

THE village authorities of West Duluth, Minn., have signed a contract with the Superior (Wis.) Water, Light, and Power Company, under which the latter will supply water and gas to West Duluth.

A VERY beautiful wedding ceremonial was that which marked the marriage of Mr. E. L. Harris, of Philadelphia, to Miss Alyce M. Smith, of Wilmington, Del. The service was read in the Wilmington Grace Methodist Episcopal Church, by the Reverends Jacob Todd, of Wilmington, and Richard Hurlburt, of the Philadelphia Spring Garden M. E. Church. The friends of the contracting parties attended in great numbers, and 400 guests paid their respects to Mr. and Mrs. Harris at the

subsequent reception and supper. The groom is the Vice-President of the firm of Harris Bros. & Co., of Philadelphia.

MR. DEARBORN, of Kane county, Ills., has introduced to the Legislature a bill authorizing the cities, towns and villages of that State to acquire, construct and maintain electric and gas plants for the production of electricity and gas for heating, lighting and power purposes.

THE following Directors were elected at the last annual meeting of the Trenton (N. J.) Gas Light Company: Wm. L. Dayton, Edward W. Evans, Geo. S. Grosvenor, Lewis Parker, Isaac F. Richey, Nathaniel H. Roberts, Isaac Stephens, Thomas S. Chambers and John S. Chambers.

IT is reported that B. Van Steenbergh and associates have applied to the Borough Council for a franchise to construct and operate a gas plant for the purpose of supplying gas in the adjoining communities of Rutherford, Carlstadt and Boiling Springs, N. J. These places are on the Erie Railroad at a point about 3 miles east of Passaic, N. J., and 8 miles west of Jersey City.

THE inhabitants of Grass Valley, Cal., are bemoaning their fate in the loss of their arc street lights; and the local electric lighting Company joins in the wail. The Company put its faith in water power, but Jack Frost this winter decided to take a hand in the affair. As usual he carried his point.

THE projectors of the Gas and Electric Light Company, for Bristol, Tenn., mention of the incorporation of which was made in a former issue of the JOURNAL, have purchased a site on Broad street in that city, and construction work will be begun early next month.

MRS. AGNES JUNIER has brought suit against the Missouri Electric Light and Power Company, of St. Louis, for damages, alleging that her husband—a former employee of the Company—lost his life on December 1, 1890, while engaged in connecting wires; and that said death was caused by the negligence and carelessness of the Company." Junier was killed by an electric shock.

AT the annual meeting of the stockholders in the Pulaski Gas Light Company, of Little Rock, Ark., the following Directors were elected: John D. Adams, James R. Miller, Dean Adams, James A. Fones and John G. Fletcher. Mr. John D. Adams was subsequently elected President.

THE residents of Allegheny City, Pa., complain that the Westinghouse natural gas meter is not a reliable measurer. They have spoken similar words respecting the meters that register their supply of illuminating gas; and so it will continue to the end.

THE good people up in Manchester, N. H., having fallen into the habit of proclaiming that the gas supplied them was not up to standard, eventually altered their complaint to keep time with the rhyme that their local Gas Company was swindling them, whereupon the proprietors of the Manchester *Press* thought it would be a good idea were an expert called in to determine just what candle power the gas was yielding. Accordingly the *Press* folks opened a correspondence with Mr. C. W. Hinman, Official Gas Inspector for the State of Massachusetts, the upshot of which was that Mr. Hinman was retained by the *Press* to try the candle power on a day not made known to the Gas Company beforehand. Mr. Africa, of the Gas Company, was then asked if he would have any objection to such a test, and, of course, he replied, "No;" and that the Company would gladly allow Mr. Hinman the use of the Company's testing apparatus. The *Press* people, however, thought it would be better were Mr. Hinman to use his own instruments, which determination was at once acquiesced in by Mr. Africa. Mr. Hinman came to Manchester on January 12, was met by a *Press* man, and both repaired to a room in the Windsor Hotel. The test was duly made, and the following report was handed in to the *Press* proprietors:

"MANCHESTER, N. H., Jan. 12, 1891.

"Frank H. Challis, Esq.—Dear Sir: I have this day tested the gas of the Peoples Gas Light Company. The gas was burned from a common slit burner, at the rate of 5 cubic feet per hour, and was found to give a light equal to 24.4 standard English candles, burning 120 grains per hour. Respectfully yours, C. W. HINMAN."

If we mistake not, the standard value called for by the statutes governing the gas companies of New Hampshire is 17 candles, wherefore he Peoples Company, of Manchester, is giving far better service than the State demands from it. Indeed, it looks like another illustration of the fact that those who receive pearls are not always up to the task of appreciating their value. It is hardly necessary to add, we presume, that Mr. Hinman was certain the Peoples Gas Company would not object to such a test before he consented to make it.

AT the annual meeting of the Newport (R. I.) Gas Light Company the following officers were chosen: President, Henry Bull; Secretary, T. A. Lawton; Directors, H. Bull, J. C. Swan, W. H. Fludder, Philip Ryder, R. S. Chase, T. A. Lawton and A. K. Quinn.

THE shareholders in the Tulare City (Cal.) Gas Company have been called upon to pay an assessment of $5 per share. It is delinquent since the 12th inst.

THE authorities of Richmond, Va., are considering the fact "whether or not it is expedient and practicable" to light all of the streets of that city by means of electric arcs.

MR. JOSEPH M. BATE has resigned his position as Manager of the American Gas Company's plant at Canton, O. He had been in charge of the works since April 1, 1887, when the American Company took the plant over, and he has the satisfaction of knowing that the output, on the average, has more than doubled in the period during which he was in charge. He is open for an engagement, and letters addressed to him at No. 32 West 8th street, Canton, O., will come to hand.

THE Milton (Mass.) Company's last or current semi-annual dividend amounted to 5 per cent.

WE wish to repeat our former intimation that the fire which dismantled the warehouse and mounting room of the Gem City Stove Company, of Dayton, O., will not prevent the Company from filling orders. This fact should be remembered, too, by the patrons of the Maryland Meter and Manufacturing Company, particularly in respect to orders for gas cooking and heating stoves.

THE Cabot and Church trays were ordered by 128 separate gas companies in the year just closed—several orders were received from abroad—or an increase of 20 per cent. over that recorded in 1889. The best evidence possible that the Cabot specialties in trays hold their own and more is found in the fact that the New York shops for their manufacture have been enlarged.

AT the annual meeting of the shareholders of the Brooklyn (N. Y.) Gas Company the following Directors were chosen: Henry D. Polhemus, Henry K. Sheldon, Alexander M. White, Henry H. Rogers, E. H. R. Lyman, A. E. Orr, W. C. Sanger, and W. A. White. The last-named appears for the first time in the management.

MR. AND MRS. JOHN JACKSON, of Philadelphia, have each entered suit for $25,000 damages against the Wissahickon Electric Light Company. The cause for action is this: On Nov. 10, 1890, complainants were driving in Fairmount Park, when their horse came in contact with an electric light wire which had fallen from a pole and trailed across the road. The horse was thrown down, the carriage was upset, and the occupants were hurled to the roadway, each sustaining severe bodily injury.

THE Union Natural Gas Company, of McKeesport, Pa., despite the fact that it can no longer obtain a reliable supply of natural gas, has elected a new board of officers, who assert that they will engage the Company in the distribution of a manufactured fuel gas.

THE City Gas Light Company, of Hartford, Conn., has elected the following Board of Directors: Hugh Harbison, Francis B. Cooley, J. L. Howard, H. K. Morgan, George Roberts, John P. Harbison, A. Collins, N. Shipman, and Rodney Dennis.

AT the annual meeting of the Gas Light Company of Syracuse, N. Y., the following results were reached: Directors, A. A. Howlett, A. C. Wood, B. W. Forbes, Frank Hiscock, J. J. Belden, Chas. Andrews, G. N. Kennedy, Thos. Molloy, Bruce S. Aldrich, D. P. Wood and Geo. F. Comstock; President, A. A. Howlett; Vice-President, D. P. Wood; Secretary and Treasurer, H. C. Babcock; Superintendent, A. C. Wood; Assistant Superintendent, J. H. Tuffs; Bookkeeper, Austin Rust.

MESSRS. GEORGE GAUSS, John Eisner, Edward Abend, Soloman Mueller and John A. Day, have been chosen to direct the affairs of the Belleville (Ills.) Gas Light and Coke Company.

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MONDAY, JANUARY 26, 1891.

Gas Stocks.

Quotations by Geo. W. Close, Broker and Dealer in Gas Stocks,

16 WALL ST., NEW YORK CITY.

JANUARY 26.

☞ All communications will receive particular attention.
☞ The following quotations are based on the par value of $100 per share.

	Capital.	Par.	Bid	Asked
Consolidated	$35,430,000	100	94½	94⅞
Central	500,000	50	—	85
" Scrip	220,000	—	95	100
Equitable	4,000,000	100	115	118
" Bonds	1,000,000	—	113	115
Harlem, Bonds	170,000	—	—	—
Metropolitan, Bonds	658,000	—	110	115
Mutual	3,500,000	100	117	120
" Bonds	1,500,000	—	100	102
Municipal, Bonds	750,000		—	—
Northern		50	—	—
" Bonds	150,000	—	—	100
Standard Gas Co—				
Common Stock	5,000,000	100	—	48
Preferred	5,000,000	100	—	90
Yonkers		50	112	—
Richmond Co., S. I.	346,000	50	—	—
" Bonds	20,000	—	—	—
Gas Co's of Brooklyn.				
Brooklyn	2,000,000	25	116	118
Citizens	1,200,000	20	85	90
" S. F. Bonds	320,000	1000	100	103
Fulton Municipal	3,000,000	100	131	135
" Bonds	300,000		100	105
Peoples	1,000,000	10	90	92
" Bonds (7's)	368,000	—	100	—
" " (6's)	94,000	—	100	—
Metropolitan	1,000,000	100	103	107
Nassau	1,000,000	25	130	—
" Ctfs	700,000	1000	95	100
Williamsburgh	1,000,000	50	128	130
" Bonds	1,000,000	—	108	112
Out of Town Gas Companies.				
Boston United Gas Co.—				
1st Series S.F. Trust	7,000,000	1000	—	87
2d " " "	3,000,000	1000	—	75
Bay State Gas Co.—				
Stock	5,000,000	50	62	63
Income Bonds	2,000,000	1000	95½	—
Buffalo Mutual, N. Y.	750,000	100	90	95
" Bonds	200,000	1000	95	100
Citizens, Newark	1,000,000	50	155	160
" " Bonds.	45,000	—	—	—
Chicago Gas Company.	25,000,000	100	42⅞	43
Chicago Gas Light. & Coke Co.—				
G't'd Gold Bonds	7,650,000	1000	84¾	85½
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1000	—	98
People's Gas and Coke Co., Chicago—				
1st Mortgage	2,100,000	1000	—	100
2d "	2,500,000	1000	94	98½
Consumers Gas Light Co., Jersey City	2,000,000	100	12	15
Bonds	600,000	1000	70	75
Cincinnati G. & C. Co.	6,500,000	100	204	205
Consumers Toronto	1,000,000	50	190	200
Central, S. F., Cal.			92	100
Capital, Sacramento, Cal			58	
Consolidated, Balt.	11,000,000	100	47¼	47½
" Bonds	6,400,000		107	107½
Citizens Gas Lt. Co., Rochester, N. Y.	500,000	—	85	110
Bonds	250,000		—	—
East River Gas Co., Long Island City	1,000,000	100	100	105
Bonds	500,000	100	100	102
Hartford, Conn	750,000	25	102	108
Jersey City	750,000	20	165	170
Louisville, Ky.	2,570,000	50	125	130
Little Falls, N. Y.	50,000	100	—	100
" Bonds	25,000	—	100	103
Laclede Gas Light Co., St. Louis, Mo.—				
Common Stock	7,500,000	100	18	18¼
Preferred "	2,500,000	100	60	60½
Bonds	9,034,400	1000	81	81¼
Montreal, Canada	2,000,000	100	200	208
Memphis (Tenn.) Gas	750,000	100	40	—
" Bonds.	240,000	100	103	—
New Haven, Conn.		25	200	—
Oakland, Cal.			34¼	35½
Peoples, Jersey City		—	60	61
" " Bonds			—	—
Paterson, N. J.		25	99	102
Rochester, N. Y.		50	99	100
Syracuse, N. Y.	500,000	25	—	—
San Francisco Gas Co. San Francisco, Cal.	10,000,000	100	58½	59
Washington, D. C.	2,000,000	20	200	208
Wilmington, Del.		50	88	90

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By a young man (33), who has had over eight years' experience—two years as manager of a small country works making water gas. Good references as to character and ability. Address

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PROPOSALS will be received at the Office of the **Camden Gas Light Company,** No. 432 Federal Street, Camden, N. J., until March 2d, proximo, for the sale of about 1,500 bbls. (45 galls. per bbl.) of Coal Tar. Delivery as made at the Company's works, in barrels to be furnished by the purchaser. Contract to be made for a period of three or five years, with satisfactory bond. The right to reject any and all bids reserved

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Coal Tar For Sale.

PROPOSALS for the entire make of Coal Tar at works of **Knoxville (Tenn.) Gas Light Company,** for five (5) years, the same being about 60,000 gallons per year, will be received at the Company's Office in Knoxville, Tenn. Tar to be delivered in tank cars at works. Not more than 20,000 gallons shall be allowed to accumulate in well at any one time. Right to use sufficient tar for Company's own purposes, and to reject any or all bids, reserved. The Company expects bids in the neighborhood of the price which other Companies are now receiving—viz., 10 cents per gallon.

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The American Gas, Light & Heat Co.,

OF

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Are now prepared to erect plants of their Oxy-Hydrocarbon Process, to carburet coal gas up to any given or named candle power required for general consumption (for instance, from 20 to 25 candles), and at a cost not to exceed one and three-quarters (1¾) cents per candle power per 1,000 cubic feet increased, with a permanent and perfectly *fixed* gas, *not a vapor*—a gas that will whiten the whole output of the works.

This gas can be furnished at a cost less per 1,000 cubic feet than the coal gas may be costing the company.

Our system is such that we can furnish plants that will carburet 50,000 cubic feet in 24 hours, or three or four million feet in the same length of time. *One* of our large benches or plants would be capable of generating 100,000 cubic feet of gas in 24 hours, which would raise the candle power on 2,000,000 feet (taking as a standard coal gas at 15 candles) 3 candles on the 2,000,000 feet, enabling the works to deliver to consumers an 18 candle gas; or, enlarging our plant, the candle power may be increased as desired, at the same cost per candle power, less interest on plant.

This is much less per candle power than it can be furnished by the use of cannel coal or by vaporizing naphtha. With our process we improve the whole output in color—viz., whiten the flame with the oxygen, as well as furnishing a *thoroughly fixed* gas, and no possible danger of separation as there is with vapor. Correspondence solicited.

J. J. NEWELL, Sec'y.

September 4, 1890.

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Extracts the Whole of the Ammonia and a Large Percentage of the Sulphureted Hydrogen and Carbonic Acid.

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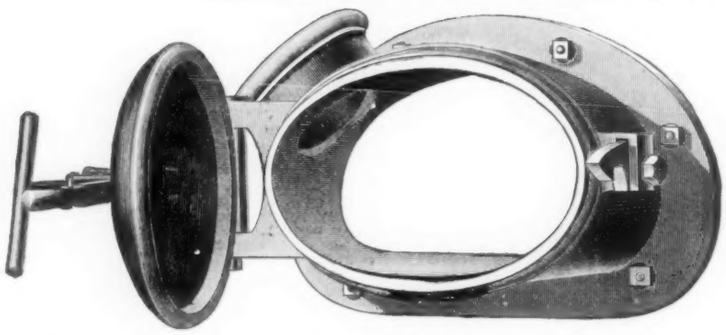

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This Mouthpiece and Lid was introduced to the public in 1884, and since then large numbers have been manufactured and sold.

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Syracuse Gas Light Company.
Taunton (Mass.) Gas Light Company.
Providence Gas Light Company
Central (New York City) Gas Light Company.
Northern (New York City) Gas Light Company.
Stamford (Conn.) Gas Light Company.
Holyoke (Mass.) Gas Light Company.
Springfield (Mass.) Gas Light Company.

Dissolution of Co-Partnership

The firm of CONNELLY & CO. is this day dissolved by mutual consent, J. S., T. E., and J. W. Connelly retiring, and S. F. Hayward continuing the business, incorporating under the name and style of the "CONNELLY IRON SPONGE AND GOVERNOR CO.," assuming all liabilities of the late firm, and authorized to collect all outstanding accounts.

J. S. CONNELLY,
T. E. CONNELLY,
J. W. CONNELLY,
S. F. HAYWARD.

The retiring members take this opportunity to thank their many patrons for the liberal patronage they have enjoyed, and would respectfully solicit a continuance of the same for the new Company, bespeaking for them an earnest desire to please in all their dealings.

J. S. CONNELLY,
T. E. CONNELLY,
J. W. CONNELLY.

We should be pleased to receive a continuance of the favors extended to the old firm, and hope, by a vigorous, energetic pushing of the business and fair dealing, to deserve it. Thanking you in advance,

CONNELLY IRON SPONGE AND GOVERNOR CO.

December 1, 1890. 812-6

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By E. J. MILLS, D.Sc. F.R.S., and F. J. ROWAN, C.E., assisted by others, including Mr. F. P. Dewey, of the Smithsonian Inst., Wash., D. C.

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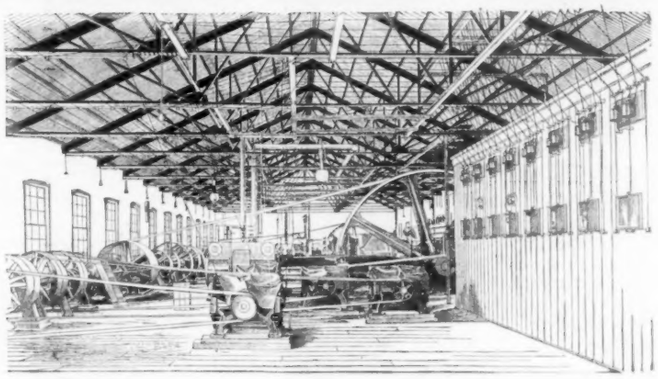

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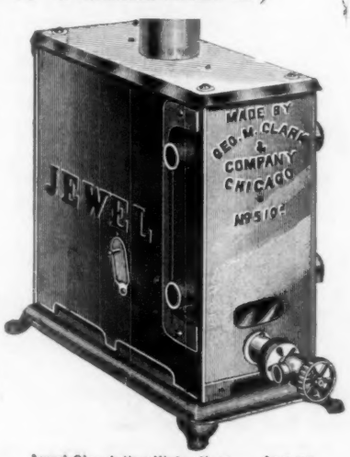

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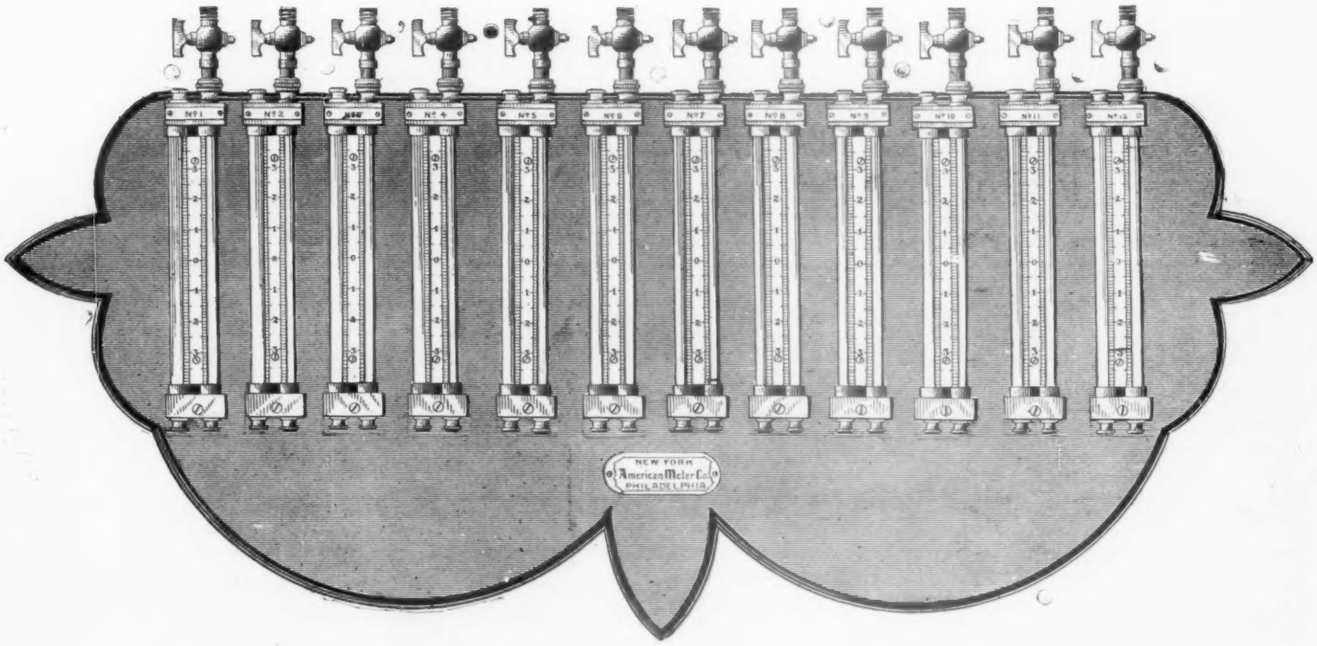

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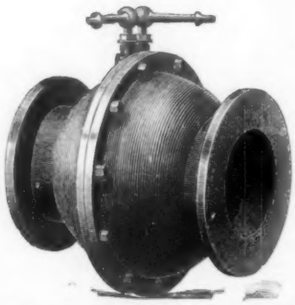

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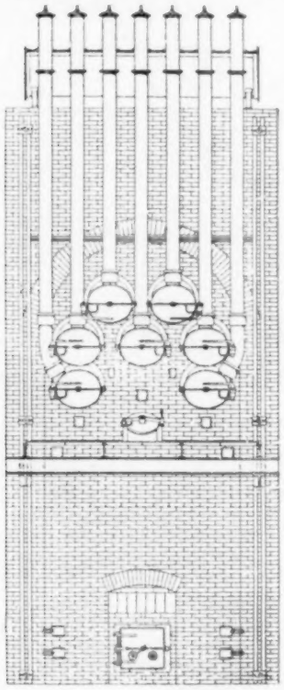

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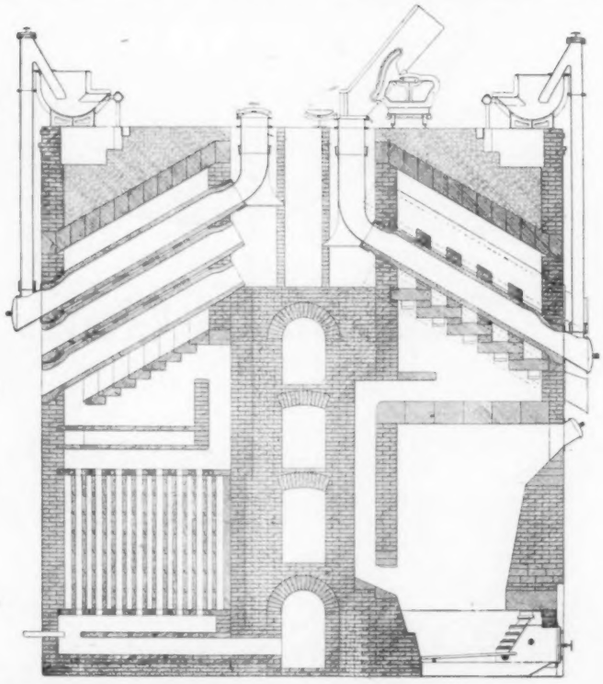

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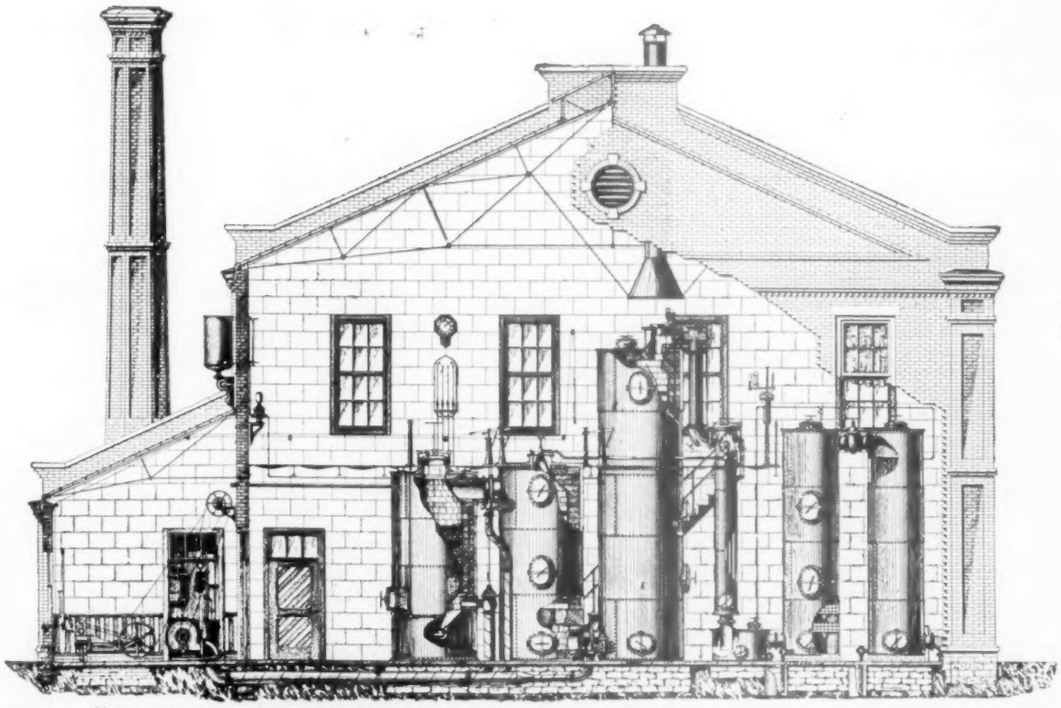

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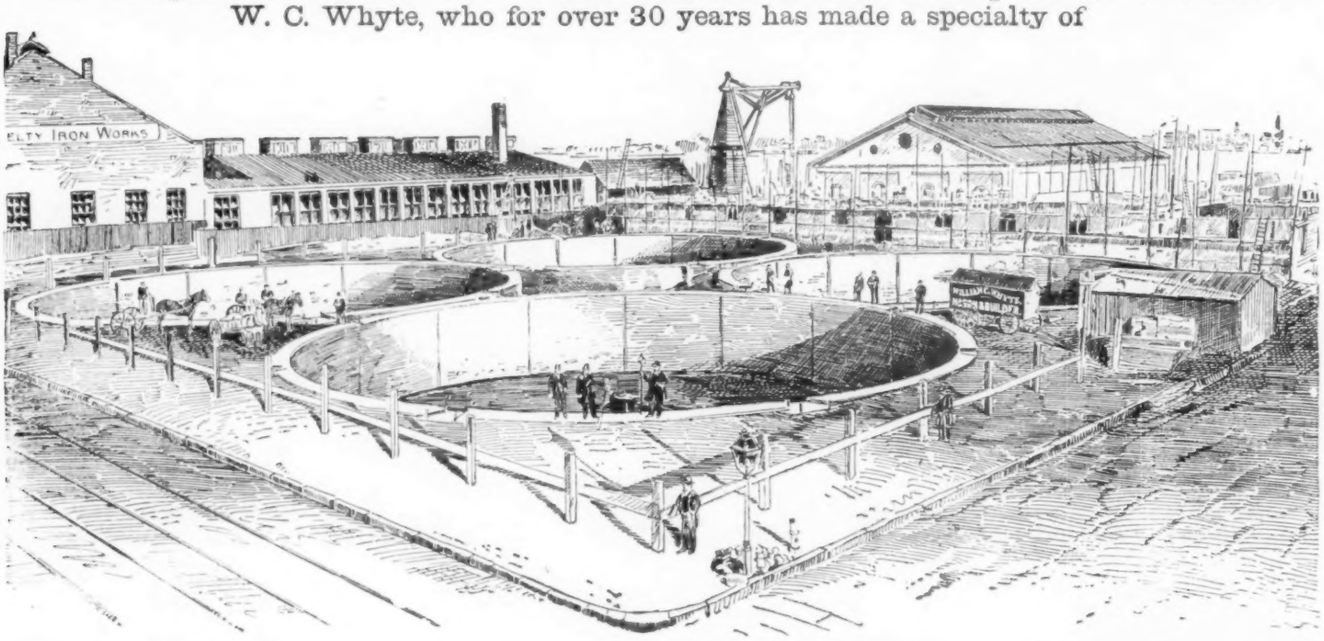

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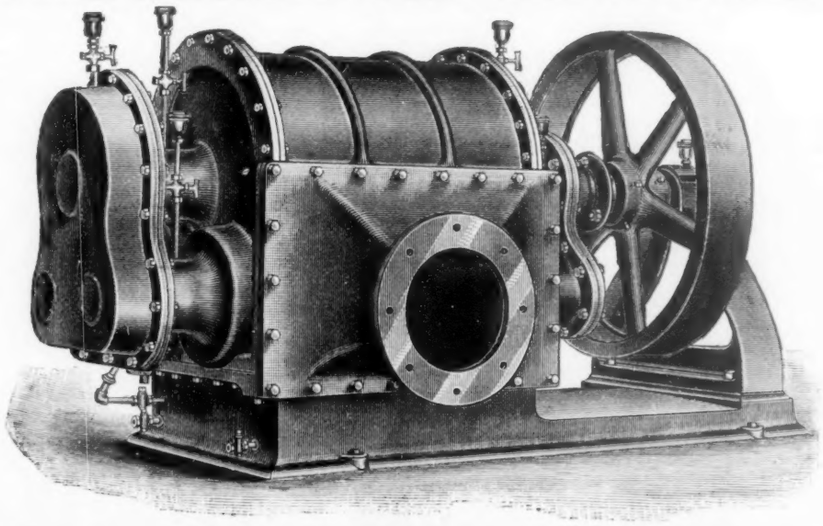

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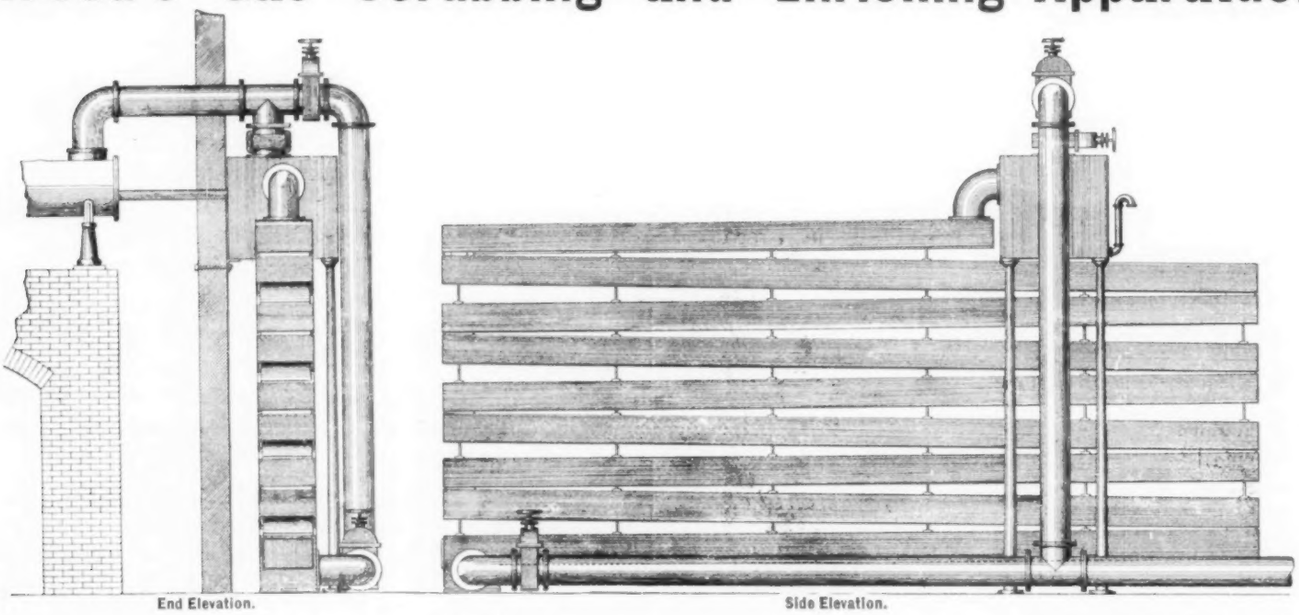

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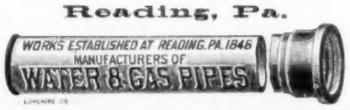

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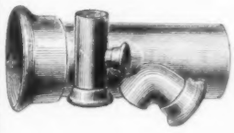

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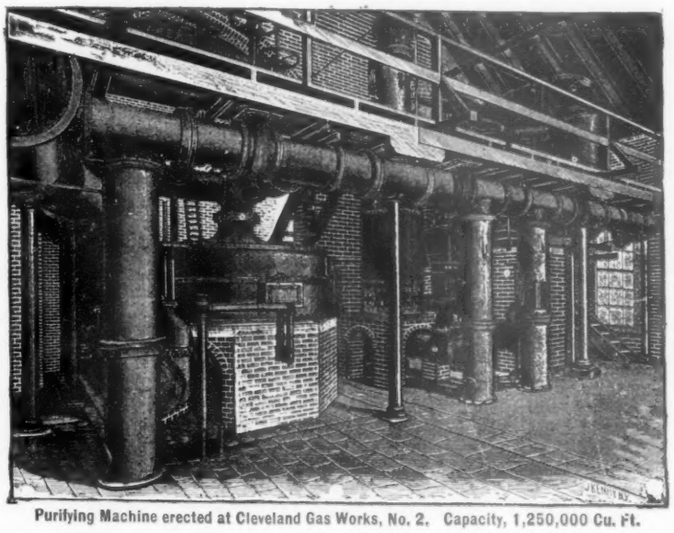

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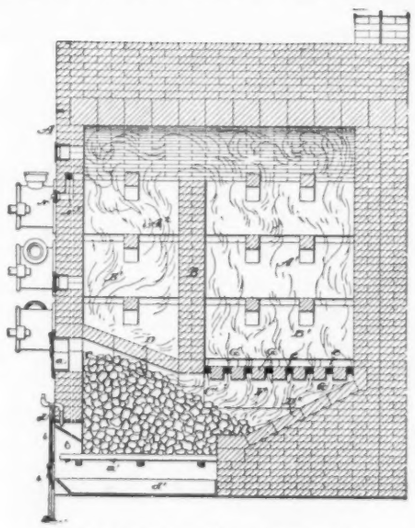

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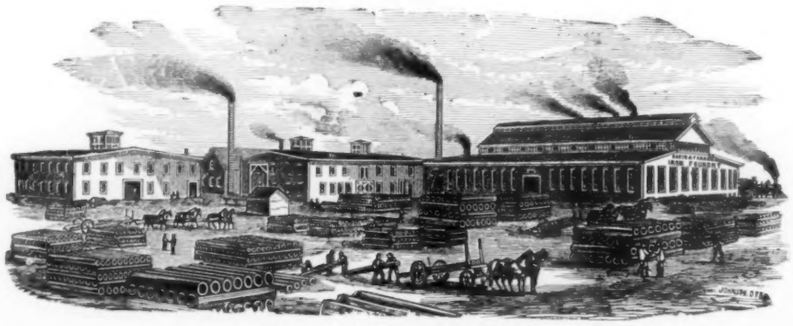

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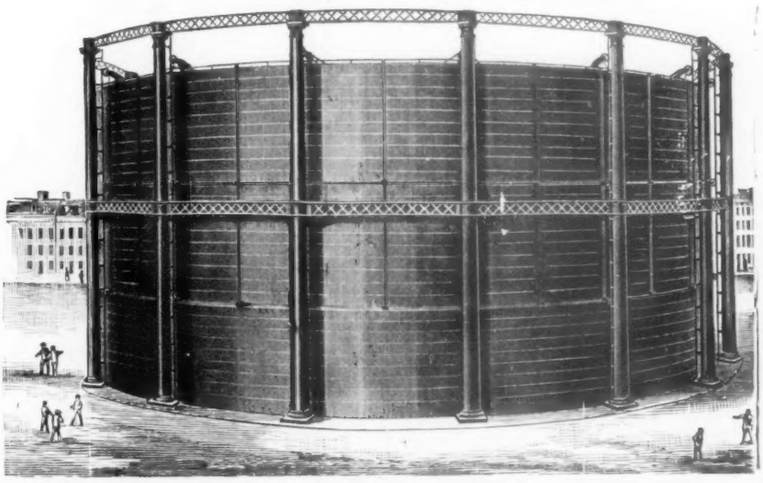

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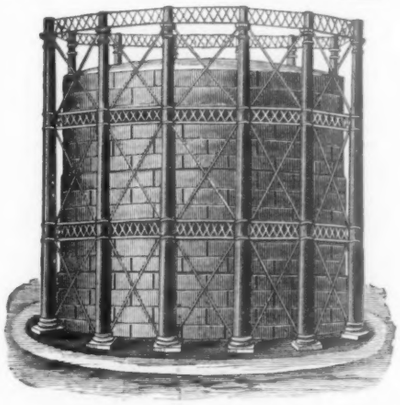

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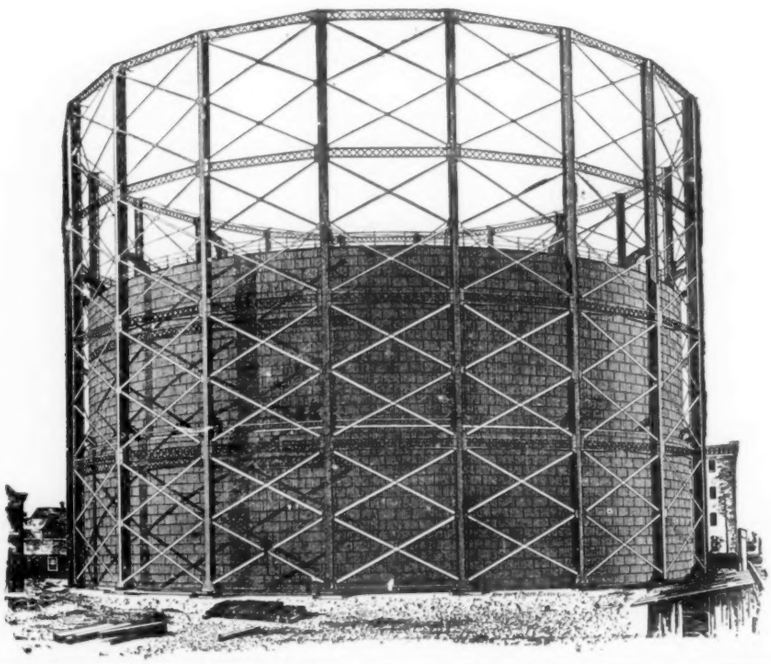

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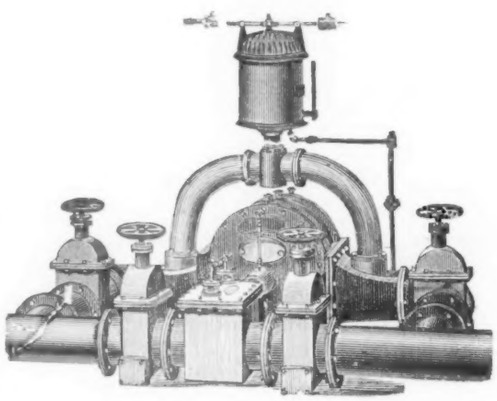

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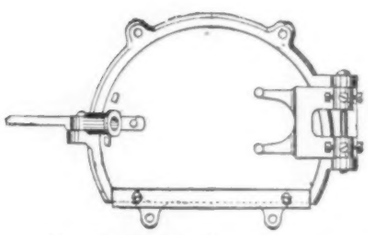

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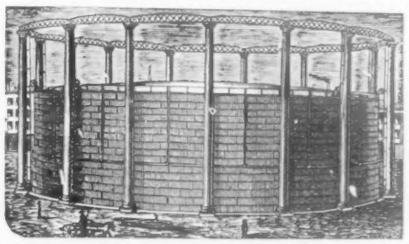
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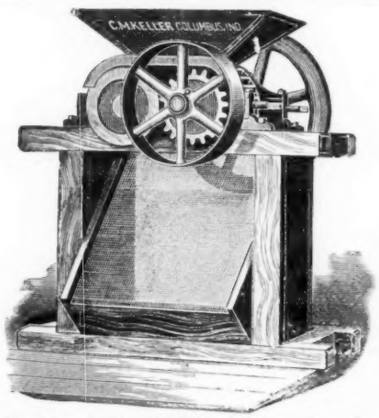

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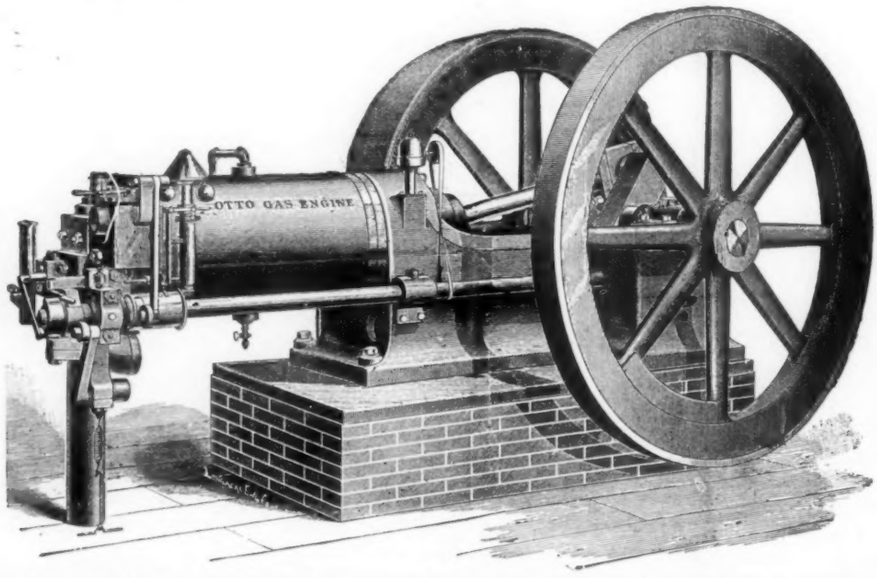

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